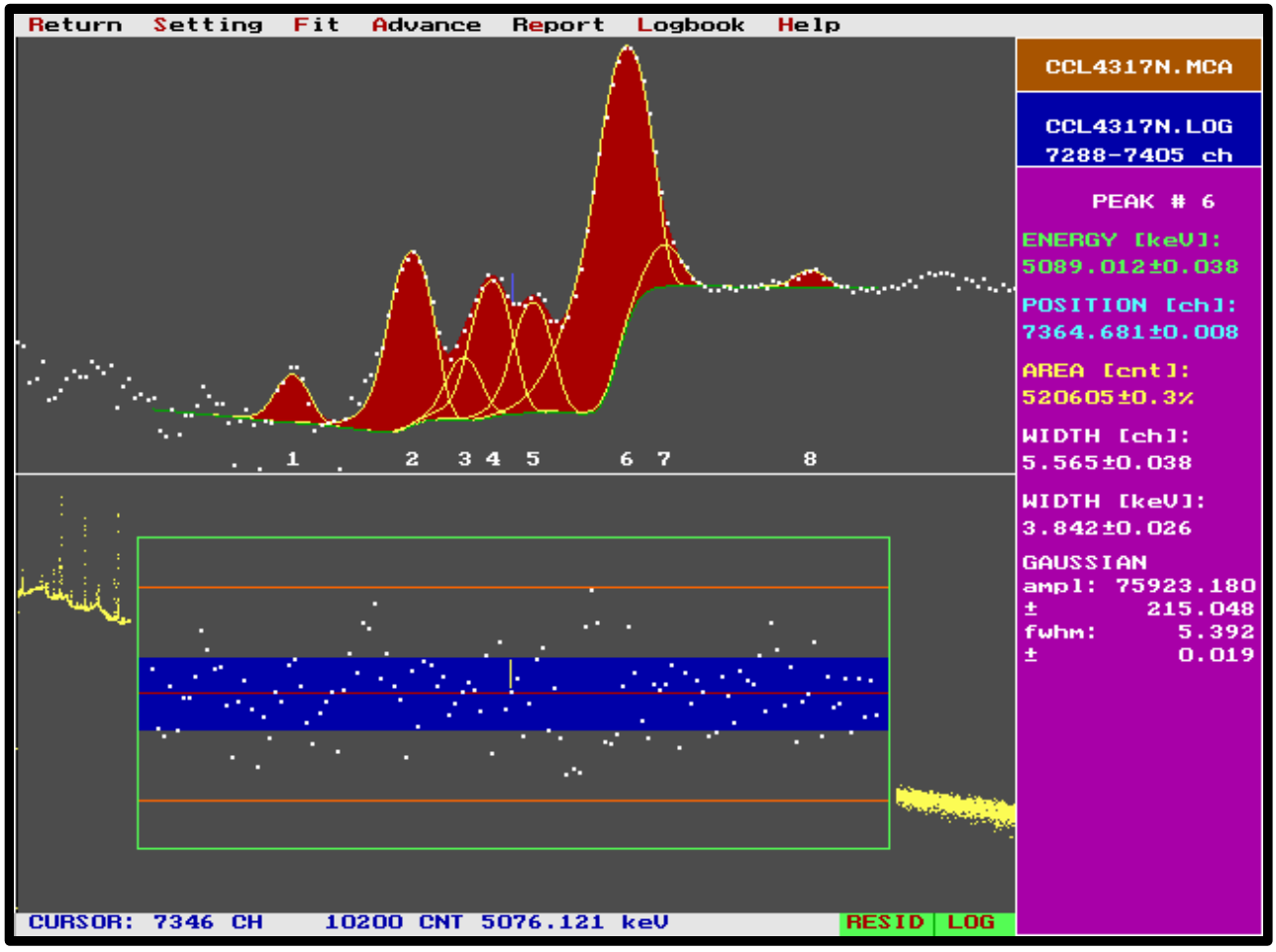
Hypermet-PC

Version 5.0

User's Manual



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Introduction

The original HYPERMET code was developed in FORTRAN by Phillips and Marlow [1] in the early seventies at the Naval Research Laboratory, Washington D.C. for automatic and efficient analysis of multichannel pulse-height spectra using a high-speed mainframe computer. The authors' governing principle has been to require minimal input from the user in order to save manpower and to minimise human errors. To achieve reliable results by automatic fitting, a carefully chosen semi-empirical parameterized function was adopted to represent the detector response, including all physical and statistical effects which contribute to a real spectrum. The peak shape function of HYPERMET is the linear sum of a Gaussian and a Gaussian with exponential tail on the left side. On the other hand, a step function folded with the same Gaussian and a similarly folded "tail" function, resembling a sharp Compton edge, are added to the usual first or second order polynomial background function. The fit becomes nonlinear as far as parameters of the Gaussians and exponentials are allowed to vary.

Fully automatic operation means that the shape parameters for peaks and background are found by a nonlinear fit for each separate region in the spectrum using an initial first trial value for the peak width. (The latter is found by a square-root interpolation from the approximate widths of two distant peaks provided by the user as the only input.) In contrast with SAMPO and its derivatives, the shape parameters are not retained but fitted again and again. Hence dynamic variations of peak shapes throughout the spectrum are automatically accounted for. Moreover, the tedious process of shape calibration so characteristic in SAMPO [2,3] and GENIE-PC [4] is not needed at all. It is merely sufficient to enter the positions and widths of two peaks, used anyway for energy calibration.

It is worth mentioning that shape calibration is difficult to accomplish even without dynamic changes due to counting rate variations. The reason is that for shape calibration a spectrum with well-distinguished, intense single peaks is required which produce peak shapes different from those of weak lines in a real spectrum. In contrast, HYPERMET "calibrates" the peak shape within each region, by tying up the parameters of weak peaks with those of the strongest peak in the multiplet. Of course, this constraint can be lifted when necessary, e.g. in the case of a multiplet containing the annihilation peak.

At the time when HYPERMET was introduced only high-speed mainframe computers could be used efficiently due to the time-consuming nonlinear fitting involved. With some modifications the program became fast enough for use on an AT-386 class personal computer. The progress of object-oriented programming languages for PCs has motivated the development of an interactive version with a user-friendly graphics environment and a built-in data base. Turbo (later Borland) C++ was chosen as an appropriate developer's platform.

An operating environment was developed as a shell, to make inclusion of additional program modules easier. It reads and writes various MCA spectrum formats such as Canberra S100, AccuSpec, Ortec ACE, SAMPO-90, ASCII and other formats and displays them on a VGA colour monitor. Although the program runs under DOS, it offers Windows-like features such as mouse controlled pull-down menus, pop-up windows and a rubber band. The expanded part of the spectrum appears in the upper half of the screen. Spectra up to 16k channels can be processed with unlimited number of peaks/spectrum. Regions of interest (ROIs) can also be read in from files or created on the screen.

Hypermet-PC is called from the **Eval** menu. Initial values for peak width and energy calibrations are read in with the spectra or created using the **Calibration** submenu. Although well-established default

values are provided for the remaining parameters [7], any of them can be modified using the **Experts** and **Fine Tune** pop-up window. In **Auto** mode the entire spectrum can be evaluated without user intervention. Still, the whole session will be recorded in a log file which contains all details of the fit. Hence each session can be replayed after the fitting is done, thus using the log file as a true data base. Any problematic region - flagged in the list - can be viewed and refitted when necessary. The residuals can also be displayed in the lower panel to facilitate manual peak insertion, in addition to automatic residual search with a pre-set number of trials. The region boundaries can be modified either numerically or graphically, by using the mouse.

During the fitting or replay, parameters characteristic to the region, (e. g. boundaries, number of peaks found, chi-square, skew, background, etc.) are displayed in the right info panel. Additional peak parameters can be found on subsequent pages. The peak positions, energies, widths, areas and their uncertainties are stored in the fname.log data base file. The **Report** menu initiates listing of peaks on screen or printer, or in a file. At present four peak table formats are supported, including the SAMPO-90 `*.PTF` file format. The latter is widely used in a number of sample analysis programs such as KAYZERO/SOLCOI, a software package for k_0 standardisation [6].

Starting Hypermet-PC

System requirements for Hypermet-PC:

Hardware:
- 386 DX CPU or above,
- mathematical co-processor,
- 2 MB RAM,
- about 3 MB free hard disk space for Hypermet-PC,
  and another 2 MB when the program is running,
- standard VGA video card (640x480 resolution, 16 colors) or better,
- mouse,
- 3,5" floppy drive (for the installation process).

Software:
- MS-DOS 6.x, MS Windows 3.x, Windows95 system (or compatible),
- MS-DOS mouse driver software from the mouse manufacturer.

Sophisticated algorithms involved in Hypermet-PC need a lot of calculations, so the specified configuration is the 'low end'. We suggest using a faster CPU (Intel 80-486 or Pentium) for complicated tasks such as fitting of multiplets or complicated background.

Installation:

Read the operating system specific section from the HINSTALL.TXT file before installation. (e.g. 'Installation under Windows 3.x')
Run the HINSTALL.EXE program from the installation floppy disk and set parameters according to your needs and your computer environment.

Initialisation of Hypermet-PC parameters

Before starting the program, take a look into the HYPC.INI file. HYPC.INI is a user-editable settings file. To eliminate the tedious task of customising basic parameters every time when user starts the appropriate program module, Hypermet-PC obtains default values for different tasks from this file when the program starts.

```
[TECHNICAL]
Win3x=No
```

The [TECHNICAL] section controls the critical error handling routine of Hypermet-PC (this causes the well-known Not ready reading drive A: Abort, Retry, Fail? message). Because the MS-Windows 3.x versions handle this event totally differently from MS-DOS or Windows95, user MUST set the Win3x variable to Yes if using this operating system, otherwise Hypermet-PC will crash when a critical error occurs.

```
[HYPC INITIAL]
InitialPath   = c:\hypc\spectra\
InitialPath   = d:\spectra\
LogDrawing    = on
ExpandDrawing = off
LineDrawing   = off
Residual      = off
DualOption    = off
UpperLogAdj   = 5.0
SpectrumType  = AccuSpec
```

This section controls the majority of the default values for displaying and file-handling tasks.

InitialPath is the directory where Hypermet-PC will try to load spectra from. It can be multiple set with more drives in consecutive text rows. During HYPC.INI processing, the program will set the directory specified for the actual drive. Therefore the drive which is set in the last row will be the default drive (in the example above the default path will be set to d:\spectra\). Unwanted drives can be disabled if the relevant line is preceded by a semicolon.

LogDrawing sets the initial spectrum display scale to logarithmic or to linear.

ExpandDrawing switches the expanded spectrum display mode on.

`LineDrawing` controls the displaying mode of counts. If it is on, then only a line is drawn between the maximal and minimal count which should be displayed in the same horizontal pixel of the screen. If it is switched off, then every count will be indicated with individual points on the screen.

`Residual` controls the opening of the residual window in Eval module. If it is on, then residual window automatically appears when user opens the logbook, otherwise it should be manually displayed with clicking on the SPECT toggle green button at the bottom of the screen.

`DualOption` switches on or off the Dual LFC option for the loaded spectra automatically. If user set this variable to `ON`, then every spectrum will be displayed in Dual LFC mode until user switches OFF the LFC mode in Main or Eval module.

`UpperLogAdj:` the larger this value, the less logarithmic the plotted spectrum is in the upper expanded window in Main or Eval module (when expanded mode is switched on). The range for this value can extends from 1 to 10.

`SpectrumType` controls which spectrum type offered automatically at spectrum load. Possible values: S100, AccuSpec, Ortec, Sampo90, Nucleus, Silena, SEIKO, ASCII, DCHYP.

```
[EVAL FIT]
Try  = 3
Auto = off
Fix  = off
ROI  = off
PeakAddError= 0.5
SettingFile = default.set
```

`Try` is the maximum number of trials, when Hypermet-PC will insert a new peak into the evaluated region at the position obtained by searching the maximum residual in order to improve the chi-square value for the fit. Minimum value is 1, maximum is 4. In general, Try=3 is acceptable for almost every region.

`Auto` holds the state of the Auto check box in the Fit pop-up window, thus controls whether Hypermet-PC evaluates automatically all the remaining regions in the spectrum (Auto = Yes) or stops after evaluating the current region.

`Fix` contains the initial value for Fix check box in the Fit pop-up window, thus determines whether boundaries of the actual region should be set automatically (Fix = No), or the fitting algorithm must use the fixed region boundaries set by the user. User can set manually the region boundaries by clicking with the right mouse button in the upper expanded window and sweeping over the preferred background holding down the mouse button. This region fixing works only if the user opened the logbook by Logbook / Regions menu.

`ROI` controls the ROI check box in the Fit pop-up window. Therefore, user can switch on this check box to set ROI variable to `ON`. In this case the fitting algorithm searches peaks only in the pre-set areas of ROIs.

PeakAddError sets the uncertainty of the peak position which is inserted by the user into a multiplet. The value should be given in channels.

SettingFile controls the automatic handling of setting files. The value assigned to this variable is the name of a settings (*.SET) file. User can place variables to the settings file which affects energy and FWHM calibration. Because user can specify the file name with or without absolute path (path with drive letter and full path), therefore user can perform sophisticated parameter setting strategies for different purposes. By default, Hypermet-PC does not use this parameter.

```
[SETTING CALIBRATION]
Fwhm1    =  493.98,    3.8
Fwhm2    = 2035.24,    4.4
Energy1  =  493.98,  344.28
EnSigma1 =    0.05,    0.05
Energy2  = 2035.24, 1408.02
EnSigma2 =    0.1 ,    0.05
EcalMode = 1
NonlinFile     = c:\hypc\det1\nonlin.lin
EfficiencyFile = c:\hypc\det1\eff.eff
```

This section provides default values for a two-point energy and FWHM calibration, and default files for nonlinearity and efficiency correction. Please note that this section can appear in SET files.

Fwhm1 is the variable containing the FWHM calibration data for the first calibration point of the two-point FWHM calibration. After the equation sign there are two numbers, the first is the channel number where the calibration point is taken from, while the second one is the approximate FWHM value for the peak which is found at the specified position.

Fwhm2 serves the second data point for the FWHM calibration line. Note that the FWHM function changes by the square root of the peak energy.

Energy1 sets the first calibration point for the energy calibration. User should specify the channel number - energy value pair after the equation sign.

Energy2 sets the second data point for the linear energy calibration line.

EnSigma1 and EnSigma2 are standard deviations of the energy calibration parameters.

EcalMode sets the applied energy calibration method. If it is set to 0, then the energy calibration is disabled. In this case the positions of peaks will be indicated only in channels. If the variable is set to 1, this means a two-point energy calibration at the pre-set calibration positions. If value of EcalMode is set to 2, then Hypermet-PC replaces the specified energy calibration points with the positions of the closest fitted peaks in the spectrum. Therefore user can ensure a proper energy calibration for a series of measurements even if there is a minor peak shift in spectra.

NonlinFile specifies the default nonlinearity file for the system. If the user starts Eval module, then Hypermet-PC loads this nonlinearity file and switches on nonlinearity correction. This may increase the precision of the energy calibration.

`EfficiencyFile` specifies the default efficiency file for the system. If the user starts Eval module, then Hypermet-PC loads this efficiency file and switches on efficiency correction. When saving a peaklist from the Eval module, the peaklist file will contain intensity data instead of peak areas. Intensity is computed as peak area divided by the detector efficiency and by the measuring time resulting in cps value at a given peak energy.

```
[SETTING EXPERTS]
Nought = 0.3, 0.5, 1.0, 1.0, 0.1, 1.0
Max    = 2.0, 2.0, 1.3, 0.1, 3.0
Min    = 0.2, 0.2, 0.7, 2.5, 500.0
N      = 0, 0, 0, 0, 0, 0, 0, 0
Sigma  = 4.0, 3.0, 6.0, 3.0, 3.0, 4.0
Limit  = 0.10, 1e-06, 1e-06, 1, 150
```

This section of HYPC.INI is intended for experts only. It contains initial values for the peak fitting algorithm which controls the process of the spectrum evaluation. For details see the attached document [7] or the online help.

```
[QUALITY CONTROL]
DegreeOfPol = 6
Residual = chi
Grid = on
```

This section contains common settings for Quality Assurance modules, such as Nonlinearity and Efficiency calibration.

`DegreeOfPol` sets the default order for the polynomial function applied in the fit of nonlinearity or efficiency curves.

`Residual` sets the default type of the lower residual window for the nonlinearity and efficiency modules. Available values are: `none`, `chi`, `difference` for hiding the residual window, for displaying the residual in chi units, for displaying the residual in keV units, respectively.

`Grid` controls whether the horizontal and vertical gridlines are displayed by default or not. If this variable is set to `ON`, then grid will be switched on automatically.

```
[PRINTING]
Printerport=1
```

This section controls the printing properties. Because Hypermet-PC prints simple text files without any formatting and sends data directly to one of the parallel ports built-in into your computer, the section provides only one variable to specify: the printer port.

`PrinterPort` variable sets the printer port to which Hypermet-PC will send data. After the equation sign, 1 should be set for LPT1 port, 2 for LPT2 and so on.

The following section defines the converting scheme for screen colours when saving screen to a Windows bitmap file (using hotkey <Alt-P>). Under the section name, one or more of the 16 colour

names should be specified as the name of the variable. Every variable defines the remapping of the pixels drawn with the actual colour on Hypermet-PC screen. The resulting colour should be defined with a triad of values from 0 to 255, for red, green and blue colour components, respectively. The numbers defines the intensity of R,G,B colour components in the compound colour.

```
[BMP COLORS]
black        = 255  255  255  ;white
blue         = 0    255  255  ;cyan
green        = 0      0    0  ;black
cyan         = 128  128    0  ;khaki
red          = 128  128  128  ;grey
magenta      = 255  255  255  ;white
lightgray    = 128  128    0  ;khaki
brown        = 0    128  128  ;greenish blue
darkgrey     = 0    255  255  ;lightcyan
lightblue    = 0      0  255  ;blue
lightgreen   = 0      0    0  ;black
lightcyan    = 192  192  192  ;lightgray
lightred     = 0      0  128  ;darkblue
lightmagenta = 255  255  255  ;white
yellow       = 0      0    0  ;black
white        = 0      0    0  ;black
```

Reading files, changing the display appearance and defining regions of interest

Start the program hypc.exe!

First you see a logo on the screen with some elements of the program display: the pull-down menu on the top and the brown info page on the right. At the bottom you can see the position of the cursor and the number of counts in the channel at the cursor position.

Click on **File** in the menu (or press <Alt>/F) then click on **Open** (or press O). The following spectrum file formats are supported by the program

System 100	(`*.mca` files used by CANBERRA S-100 MCAs)
AccuSpec	(`*.dat` files used by CANBERRA / NUCLEAR DATA AccuSpec MCA's)
ORTEC	(`*.chn` files used by ORTEC MCA cards)
SAMPO-90	(`*.spe` files generated by SAMPO-90 program)
Nucleus	(`*.spm` files generated by NUCLEUS MCAs)
Silena	(`*.dat` Silena spectrum file format)
SEIKO	(`*.chn` files used by SEIKO MCAs)
ASCII	(`*.asc` files in ASCII format used by KFKI EPCA cards etc.)
DCHYP	(special input file, developed at the Institute of Isotopes for the original HYPERMET code. It may contain more spectra in compressed form.)

Select one of the spectrum types! A scroll input window appears with the spectrum files of the appropriate type in the current directory (Figure 1). Using the scroll window you can change the directory or even the disk drive. Choose the spectrum you want by double clicking on the filename or clicking on the OK button! After the spectrum has been loaded, the information from the spectrum file appears in the info page window on the right of the screen while the spectrum is displayed on the left side. WARNING! The slope=1.0 and intercept=0.0 mean that no energy calibration is defined or loaded with the spectrum.

If you decide here not to make any spectrum evaluation, you can leave the program by clicking on the **Exit** box in the **File** menu or typing <ALT>/F then E.. You can also save the spectrum in different file formats (`*.asc` and `*.spe` at present) using the **Write** box. This way you can simply accomplish a spectrum conversion.

Change the spectrum appearance on the display!

Click on **Display** in the menu (or push <Alt>/D). The submenus are:

Line/Dots	switch between line and dot type spectrum plot
Lin/Log	switch between linear and logarithmic display
Display Group	selects a part of the spectrum
Expand Off/On	switch between normal and expanded mode

You can toggle the **Lin/Log** state quickly by clicking on a green box at the lower right corner of the spectrum display, where **LIN** or **LOG** text is seen. In the **expanded** mode two spectrum windows appear on the screen. In the lower window the full spectrum or a selected group of channels is displayed. With the rubber band you can select a section of the spectrum with no more than 512 channels. The upper window shows a selected part of the lower screen. You can change the position of the rubber band by dragging the mouse pointer inside the rubber band while pressing the left mouse button (or by pressing the <Ctrl>/arrow keys). You can also change the size of the rubber band by dragging the mouse positioned outside of it (or by pressing the <Alt>/arrow keys). By pressing the <Home> key the size of the rubber band will be initialised to its largest amplitude and returned to the beginning of the spectrum. Try to move the cursor by dragging the mouse while pressing the left mouse button (or using the left or right arrow keys). In linear display mode change the vertical scale of the drawing in the upper expanded window with factors of two by pressing the up or down arrow key.

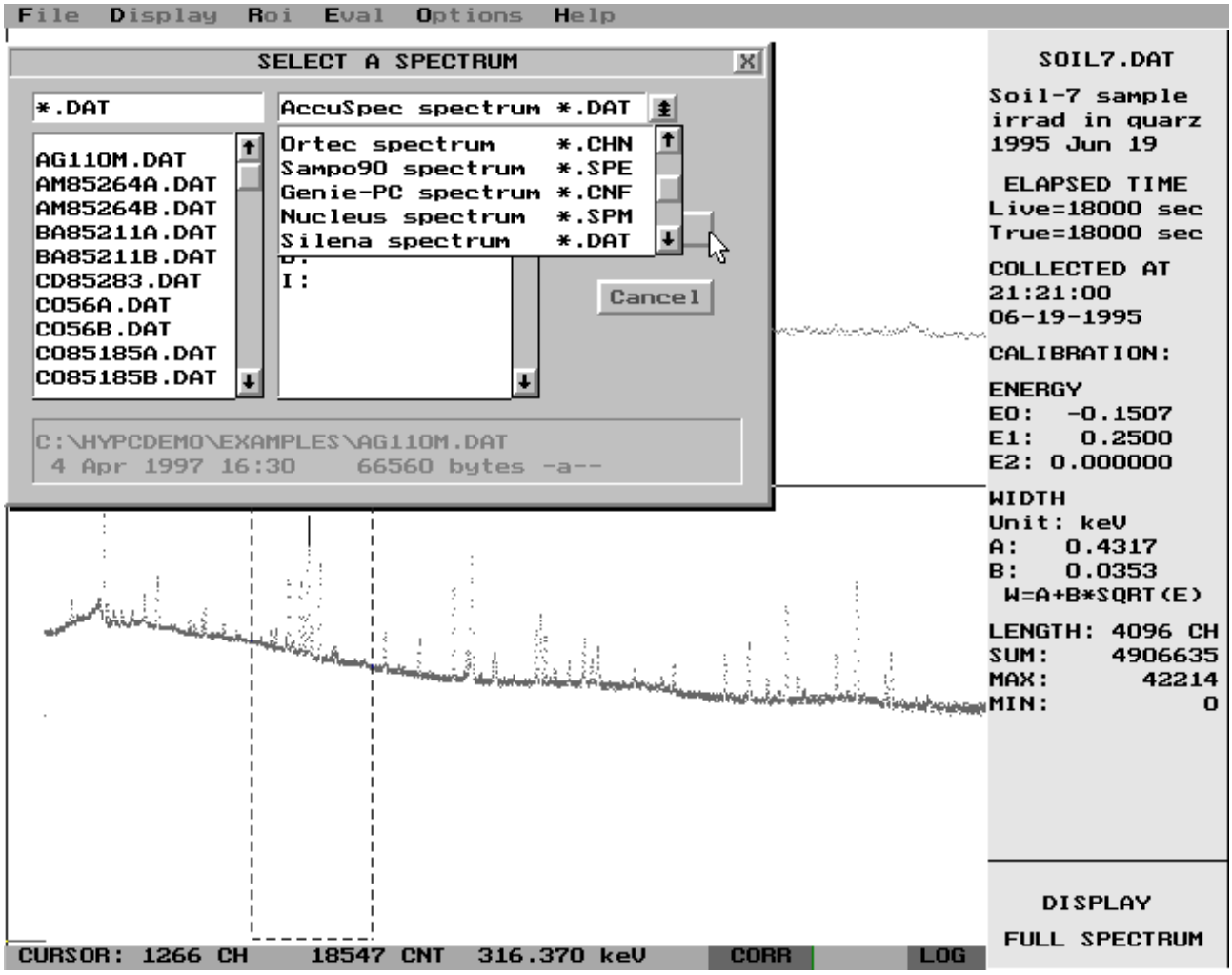

Figure 1. Selecting input spectrum format, setting display format and using the "rubber band"

Managing the Regions of Interests (ROIs):

By pressing the right mouse button and dragging over a portion of the spectrum you can mark ROIs. You can also use the < and > keys for this purpose. Starting from inside of a ROI you can delete one side of the ROI, or split the ROI into two pieces. A single ROI can be deleted by moving the cursor onto the ROI and pressing the <Delete> key. If you use expanded mode you can do it only in the upper window. You may load or save ROI files using the **ROI/Load** and **ROI/Save** submenu. You can clear all of the ROIs from the spectrum using the **ROI/Clear** menu selection.
WARNING! Sorry! If you don't have a hardware key, you can not proceed to the **Eval** menu!

Fitting spectra and managing fit results

Select the Eval menu!

When a HYPERMET session is started, a scroll window appears asking you to select a log file. You can choose an existing log file or you can open a new one if you enter a new filename with the supported `. *.log` extension in the text window. The quickest and most common way is to push the `NEW` button and the log file will have, by default, the same name the input spectrum file has. The log file subsequently stores the results of fittings that you make, or have made before. So, if you want to continue an evaluation started in a previous session, it is strongly recommended to read in such a log file that has been made with the same spectrum that you have just opened! In case you deliberately want to open a different log file the scroll window will still help you, because an existing log filename closest to your spectrum filename will be offered.

Try out the HYPERMET module!

After you have opened the HYPERMET session the program automatically switches to extended display mode and offers a new pull-down menu tree:

Return	returns to the previous session.
Setting	sets parameters for fits.
Fit	starts to fit one or more regions.
Advance	helps you to fit an other region or look at fitted regions successively.
Report	makes report in different forms to different output devices.
LogBook	manipulations of the region and peak databases.

Before you start fitting a spectrum,

Take a look at the pre-set parameters in the setting menu!

Select **Setting** from the menu! Selecting the **Calibration** submenu, a calibration window appears, where user can set the method of energy calibration and define the two-point energy and FWHM calibration data points. With the **Experts** submenu you can change the original HYPERMET fitting parameters. The explanation of these parameters is beyond the scope of this quick tour (for details

see the attached document [7] or the built-in context sensitive help). It is advisable to leave them unchanged unless you are an expert on HYPERMET! Some of these can be modified from the **Fine Tune** submenu through a user-friendly interface. With the **Load** and the **Save** submenus you can save these settings to a text file similar to the `HYPC.INI` or load a previously created set file. With the **Nonlinearity** and the **Efficiency** menu the corresponding calibration files can be read in. Using the nonlinearity calibration file possible systematic errors in gamma-energies caused by nonlinear spectrometer componenets are corrected, while the efficiency calibration file is used to calculate intensities from the fitted peak areas. These features can be switched on and off from this menu. The calibration files are created by the Nonlinearity and Efficiency utilities (see below). The set files have `*.set` extension by default, and you may also put comments there preceded by a semicolon (Figure 2).

```
; Set file for an AEKI HPGe Detector 3, Eff.:13 %, FWHM:1.74 keV; d=20.35 cm
;(ref. distance), Energy range: 40 - 2000 keV, MCA: ACCUSPEC/B card, CI 2020 MOD
; amplifier, ND 583 8K ADC, LFC ON, PUR ON
; A. Simonits, May 22, 1995.

[SETTING CALIBRATION]
Fwhm1 = 238.200000,3.500000                ;Position,FWHM (ch,ch)
Fwhm2 = 5330.000000,6.500000               ;Position,FWHM (ch,ch)
Energy1 = 238.200000,59.450000             ;Position,Energy (ch,keV)
EnSigma1 = 0.040000,0.003000               ;Standard deviation (ch, keV)
Energy2 = 5330.000000,1332.500000          ;Position,Energy (ch,keV)
EnSigma2 = 0.020000,0.006000               ;Standard deviation (ch, keV)
EcalMode = 1
;NonlinFile = nonlin.lin            ;Default nonlinearity calibration file
;EfficiencyFile= eff.eff            ;Default efficiency calibration file

[SETTING EXPERTS]
Nought = 0.3,0.5,1.0,1.0,0.1,1.0
Max = 2.0,2.0,1.3,0.1,3.0
Min = 0.2,0.2,0.7,2.5,500.0
N = 0,0,0,0,0,0,0,0
Sigma = 3.0,3.0,6.0,3.0,3.0,4.0
Limit = 0.10, 1e-06, 1e-06,1,150
```

Figure 2. A typical `*.set` file

Start to fit a spectrum!

Select **Fit** from the menu! An input window appears with the following parameters:

Left ch	The left edge of the region you want to fit.
Right ch	The right edge of the region you want to fit.
Width	Initial peak width (you can change its default value, calculated from the HYPC.INI file at... CH number.)
Try	The number of trials to find peaks in the residual.
Peak Integration	Simple integration of peaks with distorted shape, between the boundaries of the painted region
Auto	Switch to perform automatic fit over the selected region.
Fix	Switch to perform fit with fix region boundaries.
ROI	Switch to perform fit only in the ROIs.

While the program is running, a **FITTING** text appears in the upper right corner of the screen with a revolving line.

WARNING! In the HYPERMET program 200 channels is the maximum size for a **FIX**ed region which may contain not more than twelve peaks! Less than four **TRY**s are recommended!

Start fitting by selecting OK! After each successful fit, the program will display the results graphically in the upper spectrum window, and in text form on the info page, where you can see the parameters of the fitted region:

left-right	left and right boundaries of the fitted region.
CALIBRATION	sources of the width and energy calibrations
CORRECTIONS	sources of nonlinearity and efficiency corrections
TRY	number of tries that have been performed.
PEAK(S)	number of peaks that have been found.
CHSQ/(X*SIG)	ratio between the reduced chi square and 1+X*sigma limit.

Fitted Position and Area values of peaks.

On the last info page you will find the following data set:

CHSQ	reduced chi square of the fit.
X*SIGMA LIMIT	1+X*sigma.
SKEW PARAMETERS	
A	normalised amplitude of **SKEW**.
B	normalised divider in the exponent of **SKEW**.
C	relative width of **GAUSSIAN** in **SKEW**.
BACKGROUND	
bkg	average of **BACKGROUND**.
slope	slope of **BACKGROUND**.
curv	curvature of **BACKGROUND** if exists.
step	normalised amplitude of **step** if exists.
tail	normalised amplitude of **tail** if exists.
v	normalised divider in the exponent of **tail**.

The **SKEW** is an exponential function convoluted with a GAUSSIAN, representing the left side tail of the peak. It is added to the symmetric GAUSSIAN peak shape function with a normalised amplitude A. The **step** is a step function convoluted with GAUSSIAN in the background. The **tail** , resulting from the incomplete charge collection of the detector, is similar to the **SKEW** but it belongs to the **BACKGROUND**. For detailed description of these parameters see Ref. [1].

If you have made a single region fit you can continue fitting with the next region by clicking on the **Advance** box (Figure 3).

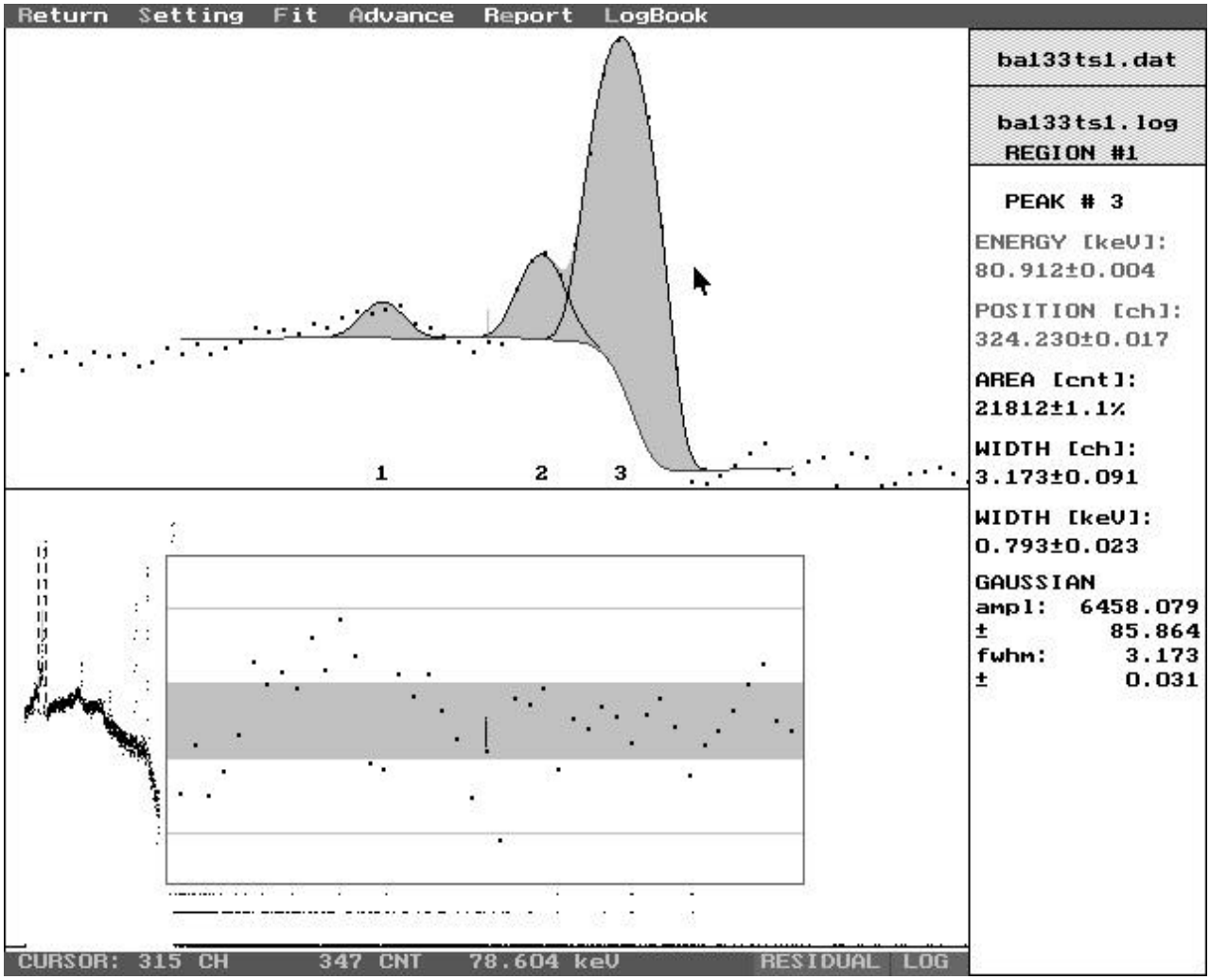

Figure 3. Automatic fit for a ^{133}Ba test spectrum

Look at the peak parameters!

By pressing the <PgUp> or <PgDown> keys you can scroll through the info pages of each fitted peak. These windows contain the following parameters:

PEAK #	serial number of the peak in the region used to mark peaks on the plot
ENERGY	energy of the peak if the energy calibration exists.
POSITION	centroid of **GAUSSIAN** in channel unit.
AREA	net area of the peak (including **SKEW**).
WIDTH [ch]	FWHM of the peak (including **SKEW**).
WIDTH [keV]	same as above but in energy unit.
GAUSSIAN	
ampl	amplitude of fitted **GAUSSIAN** [counts].
fwhm	width of **GAUSSIAN** [channel]

Examine the fitted regions or peaks!

The log file allows you to replay the fitting results and examine them in detail. Clicking on the **LogBook** menu, you will find the **Region** and the **Peak** submenus. Select one of them then choose the **View**. A scroll window will pop up with a list of the fitted regions or peaks, whichever chosen. You can display them in channel or energy units. Select the region or peak you want to examine then click **OK**. The program will display the fit of the selected region or the region containing the selected peak. If you want to look at the residual window or rather want to switch it off, click on the **SPECTRUM/RESIDUAL** toggle box at the lower right side of the display. You can successively display the regions with ascending or descending serial numbers by pushing the Gray + and Gray - keys, respectively. If a **REFITS** string turns up in the bottom of the region info page, it means, that you have made alternative fits for that region. You can scroll the alternative fits by clicking on the << or >> icons appeared next to the **REFITS** prompt or by pushing the left or right square brackets. The fit, that you leave last on the screen, will be the preferred alternative stored in the region list. However, any other alternative can still be retrieved from the log file unless deleted deliberately.

Managing Regions and Peaks

In the LogBook menu you will find the following submenus:

Region

View	displays fitted region.
Delete	permanently removes the region from the database.

Peak

View	displays region containing the peak.
Delete	removes the peak from the peak database.
Insert	adds new, unevaluated peak to the database.
Load List	loads unevaluated peaks from different files.

The program always attempts to fit first those peaks in a region selected, which are included in the peak database. When you select the **Region/View** menu item you will find a scroll window, showing the first and last channels of each region. Some of them are flagged with an asterisk indicating that the normalised chi-square of the fit is larger then unity, i.e. a new try is justified to improve the fit.

In the scroll window of the peak database the nonsignificant peaks (where the standard deviation of the area is larger than the area itself) are also flagged by an asterisk, and the unevaluated peaks are marked by a letter u.

In the **Peak/Insert** menu the position of the cursor is taken as the peak position with ±0.5 channel error as default. You can change both the peak position and its error by editing a pop-up window during the **Peak/Insert** session.

WARNING! The program considers those peaks identical, which are positioned within three standard deviations of the peak centroid. Consequently, if the peak you wish to add to the database, is closer to an other existing peak than one and a half channels, you have to decrease the default error of ±0.5 channel by typing in a smaller value.

Try to improve a bad fit!

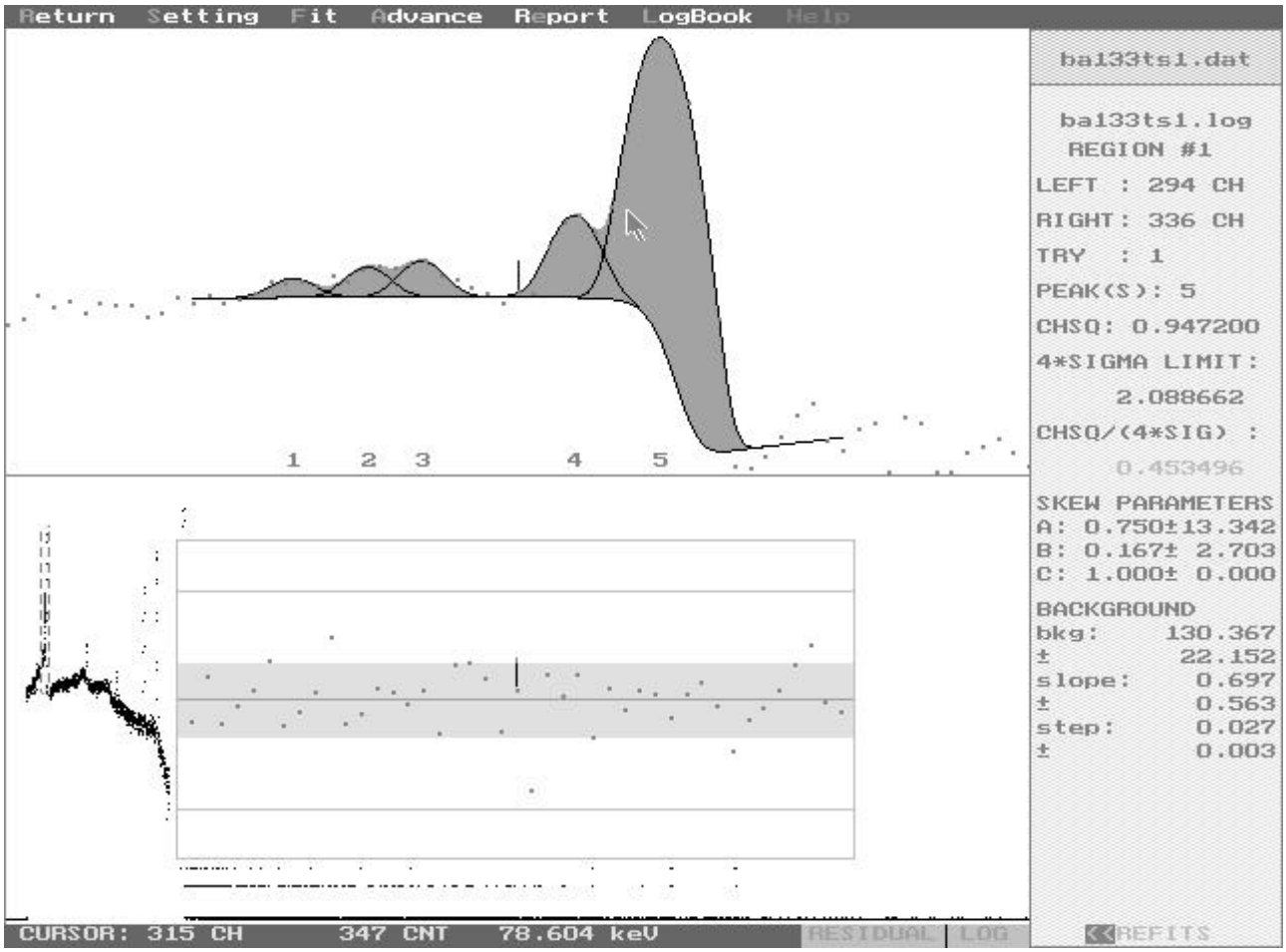

Figure 4. Repeated fit (REFIT) by adding new peaks with the help of residuals (see also Figure 3)

Sometimes the program is unable to fit a region satisfactorily in automatic mode. You can easily find those regions in the region scroll window, because they are flagged by asterisks, or when looking through the fitted regions you will find the **CHSQ/(X∗SIG)** value displayed in red on the info page. Select one of these regions!

You can make a new fit by changing and fixing the region boundaries, adding or deleting peaks in the database or sometimes by changing the HYPERMET parameters. (Figure 4). To make boundary changes easier, you can drag the mouse on the upper spectrum window while pressing the right mouse button. The channels selected for the region turn into blue.

Select **Fit** from the menu, and start a new fit. If the newly fitted region encloses an older fitted region or the boundaries of the new region are approaching the older region's limits within more than 2 x FWHM, the program takes the new result as a **REFIT**, and replaces the older one.

That's the end of this quick tour. Make a report!

Before you exit the program, you may want to make a report. Click on the `Report` menu and create a `PeakList` on the printer or screen or send it to a file [Figure 5.]. In the last case you will be prompted to give a file name. The `Short` list preserves the original HYPERMET output file structure. You can also create SAMPO-90 compatible `*.PTF` file here in a similar way as done with the `*.log` file (the use of the `NEW` button is also possible). Note, that a relevant *.SPE file is automatically created together with the *.PTF file thus providing full compatibility with SAMPO-90. By exit you will be prompted to keep or discard the `*.log` file but not the `*.set` file. Thus if you want to keep your settings, please save it into a file by clicking on the **Setting/Save** button before quitting. To leave the program, select **Return** then **File/Exit**.

```
Sun Mar 23 20:23:33 1997      Spectrum: BA85211A.DAT      Logfile: BA85211A.LOG
D3 cal. new preampl+new 8715 ADC+new 6VBIN 1995 NOV 27

Internal Version : v446
Acquisition Date : 11-27-1995 17:11:00
Live Time: 1800.00 sec
True Time: 1800.00 sec
Nonlinearity correction: DUALLFC.LIN
```

Peak No.	CHSQ/ SLIM	PEAK POSITION CHANNEL	PEAK POSITION ENERGY	E-UNC	FWHM keV	FWHM UNC	PEAK AREA COUNTS	PEAK AREA %UNC
1	2.6	92.749	23.122	0.036	0.90	0.08	3906	7.1
2	2.6	104.903	26.162	0.046	0.90	0.08	2343	11.6
3	2.6	110.961	27.677	0.176	0.90	0.13	1155	23.9
4	2.6	119.002	29.689	0.162	0.90	0.13	1991	20.8
5	0.7	213.301	53.279	0.057	0.75	0.15	708	16.7
6	3.2	301.805	75.420	0.160	0.72	0.09	1240	22.4
7	3.2	305.486	76.341	0.005	0.72	0.08	1821	17.5
8	3.2	309.333	77.303	0.065	0.72	0.07	2005	14.4
9	3.2	318.534	79.605	0.016	0.72	0.04	7048	5.5
10	3.2	324.098	80.997	0.005	0.72	0.03	122565	0.8
11	0.7	642.362	160.624	0.021	0.82	0.05	4785	3.7
12	0.3	892.577	223.226	0.010	0.88	0.03	3005	2.5
13	0.7	1105.029	276.377	0.004	0.93	0.02	36949	0.7
14	0.7	1210.825	302.844	0.006	0.95	0.02	86774	0.4
15	0.6	1423.374	356.013	0.004	1.00	0.02	248172	0.2
16	0.5	1534.674	383.852	0.005	1.02	0.02	32817	0.5
17	0.6	1747.158	436.996	0.060	1.11	0.15	110	12.1
18	0.1	5844.691	1461.084	0.079	1.34	0.12	41	9.2

Figure 5. `PeakList` of a ^{133}Ba spectrum. Note the presence of weak ^{40}K background line (last line)

About the region and the peak databases:

The aim of the log file is to store all fitting results for later use.

The region database is created when the HYPERMET session starts. Its records are in the memory. Only the preferred regions of the **REFIT**s are kept in the database. The records are ordered according to their position in the spectrum. This database helps arrange the fitted regions in connection with the log file.

The peak database, ordered in ascending peak position, is also in the memory. This database collects the peak parameters obtained from the fits. When you are to make a refit, you may set the TRY parameter to 1, because peaks that have been found in the residual search of previous fit(s), will also be considered in the first attempt. You can create the peak database from a report of an other spectrum recorded even with different amplification. In this case you have to read the energy of the peaks into the database from the report file. The peak database never contains identical peaks. The program takes two peaks as identical, if the distance between them is less then three times the error of the peak positions. If identical peaks appear in more fitted regions, the peak with a smaller relative error on its area will be kept in the database. You can check which region belongs to the peak using the **LogBook/Peak/View** feature. An unevaluated peak is always replaced with the identical evaluated peak if it exists.

THE VARIABLE PEAK WIDTH feature

When using a pre-set Peak Width vs. Energy function (usually given in the form of *a+b*sqrt(E)* in a *.set file) the evaluation of the 511 keV annihilation peak in the spectrum to be processed is usually causes problems (it is fitted with many peaks etc.). Compared to the neighbouring peaks this peak is usually very broad (about two times the expected value). The situation is more acute when close lying peaks are superimposed to the 511 keV peak as seen in Figure 6. The solution of the problem is to make a REFIT in the given energy range after enabling Variable Peak Width option in the **Setting/Fine Tune/Peak** submenu by switching Gaussian width to be variable, and using an increased initial Peak Width value (for example 8 instead of 4). The result is shown in Figure 7.

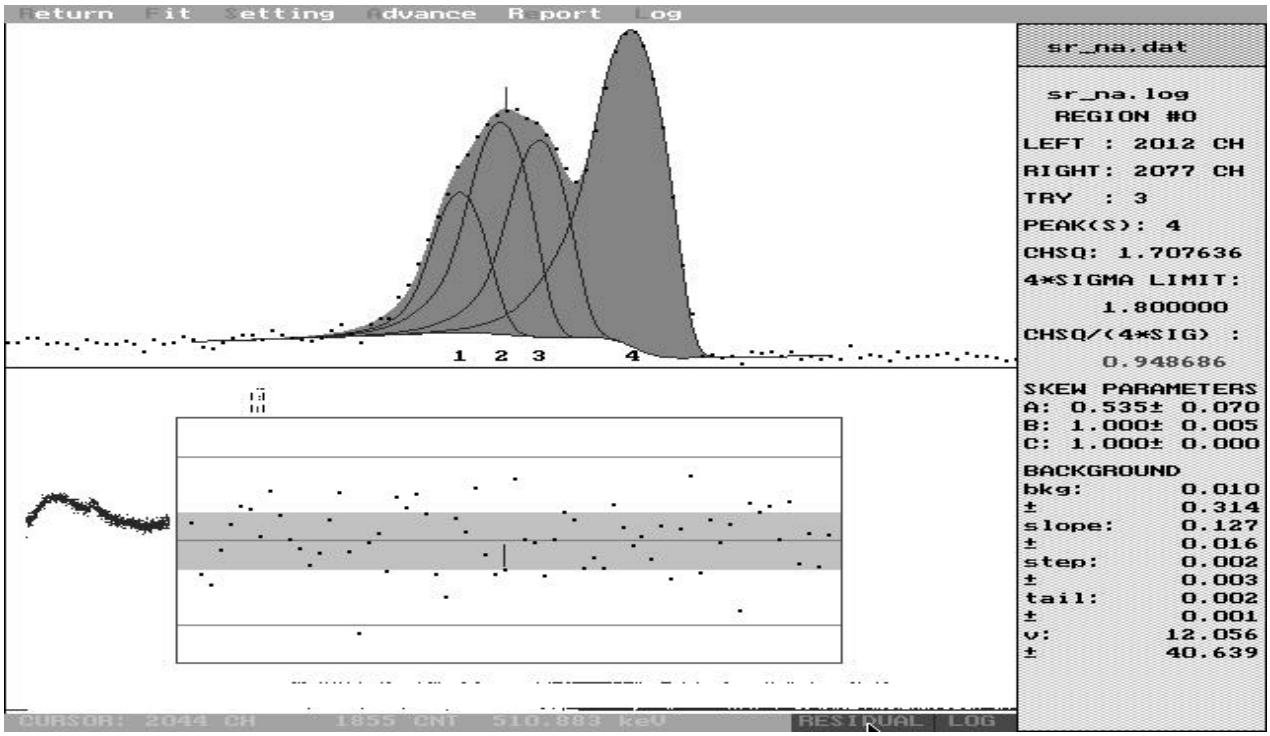

Figure 6. Typical HYPERMET fit for the 511 keV annihilation + 514 keV ^{85}Sr multiplet when using pre-set Peak Width vs. Energy function and automatic peak processing.

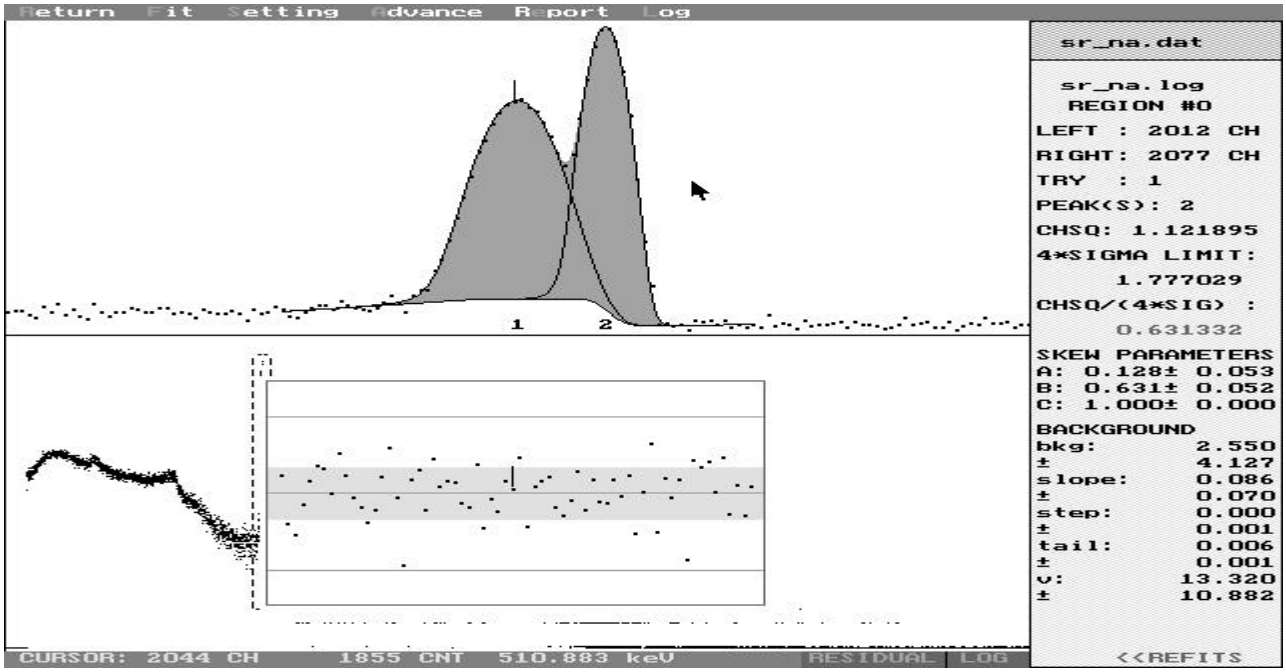

Figure 7. Repeated fit (REFIT) for the above 511 + 514 keV multiplet using the Variable Peak Width option

OPTIONS

Optional program modules are available from the **Options** menu:

Qual.Assurance	
ADC test	ADC nonlinearity test
Nonlin	spectrometer nonlinearity calibration,
Efficiency	detector efficiency calibration using standard gamma sources.
FWHM	not implemented yet.
Nuclide ID	nuclide identification
Dual LFC	initiates an evaluation of "Dual Loss Free Counting" spectrum

1. The Quality Assurance option

ADC test utility

The linearity of a Ge spectrometer's response to radiation is an important performance parameter which depends on the linearity of its components such as amplifiers, ADC's etc. Two different linearity specifications are required: the *integral nonlinearity*, and the *differential nonlinearity*.

The integral nonlinearity is a measure of the deviation from an ideal, straight line calibration curve. For the whole spectrometer this parameter can be determined by measuring a number of gamma-ray standards with well known energies. This approach eliminates the need of a very stable and linear pulse generator but has the disadvantage of being time consuming. The other advantage is that this really tests the whole system in the same circumstances where it is used. However, this procedure can not scan the ADC channels one by one, therefore one may wish to perform the integral nonlinearity and the differential nonlinearity measurement using a pulse generator. This utility program help present the result of such a measurement for an ADC with up to 16K channel conversion gain.

The differential nonlinearity specifies the non-uniformity of the ADC's channel widths. For the measurement, a sliding pulser signal (e.g. BNC PB-1 Pulser with LG-1 Ramp Generator) should be connected to the ADC input. In order to reduce the statistical error, the measurement typically takes 10-24 hours to collect sufficient data (usually 100 000 counts in each channel). The differential linearity - expressed in percentage - is the maximum deviation of counts in any channel compared to the average number of counts in all channels.

With the **ADC test** utility you can easily evaluate such spectra recorded with a sliding pulse train. First select the appropriate spectrum formats (`*.DAT, *.CHN`, etc.) then read the spectrum in. Next, select **Qual.Assurance** then **ADC test** from the main menu. The program automatically determines the lower and upper limit of a range , then calculate the average count for all selected channels as well as the differential nonlinearity parameter. The whole range is displayed in the lower

half, while a 20 -30 channel range in the vicinity of a defective or “worst channel” is displayed in the upper half of the screen. All calculated parameters are listed in the info page (Figure 8).

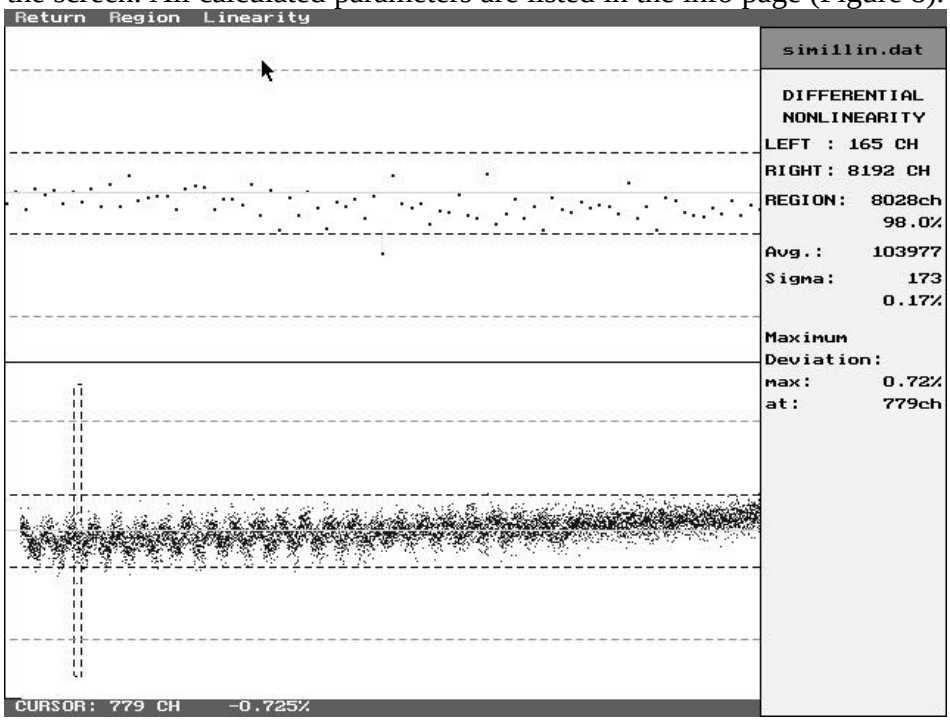

Figure 8. Differential nonlinearity curve of an ND 583 ADC

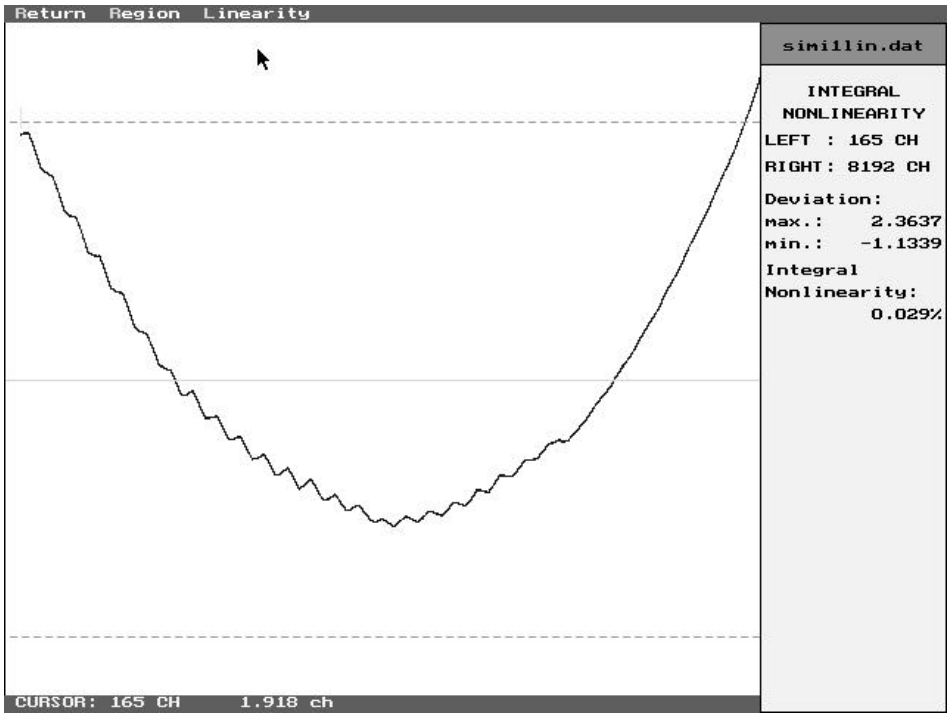

Figure 9. Integral nonlinearity of an ND 583 ADC

A unique feature of this utility is the integral linearity curve (Figure 9) constructed from the measured difflin spectrum. To activate this submenu, select **Linearity/Integral** from the menu bar appearing when the difflin spectrum and results are displayed. This way you can simply obtain the required quality parameters of your ADC.

Nonlinearity calibration module

With the Nonlinearity utility you can easily determine the nonlinearity of your entire measurement system. The aim of this procedure is to improve the accuracy of the energy calibration.

For accurate results, user should

- determine the nonlinearity of the system and check it on a regular basis for each measuring set-up using the Nonlinearity module, and
- apply the saved nonlinearity calibration file (the .LIN file) every time before creating a peaklist report in the Eval module.

The chance is small to determine high-precision peak positions in energy units without nonlinearity correction. This is especially important when using Efficiency and Nuclide Identification modules because the applied algorithms try to locate peaks in the vicinity of their literature energy values with certain energy window (typically ± 0.5 keV) In practice, by neglecting nonlinearity calibration beside the two-point energy calibration, a rather large deviation in peak positions can be expected (1-3 channels), and incorrect uncertainty data will appear in the peaklist report files (in general, uncertainties will be smaller than the real values if user do not apply nonlinearity correction). This will prevent accurate peak identification using Efficiency or Nuclide Identification modules.

Nonlinearity correction results in significant improvement in accuracy on peak centroid determination and takes only a few minutes to create. Thus it is advisable to use nonlinearity correction whenever the user generates a peaklist file in Eval module.

The menu structure:

File

New	creates a new nonlinearity log file
Open	opens a previously saved nonlinearity log file
Save	saves the nonlinearity log file
Save as	saves the nonlinearity log file
Return	control returns to the Main module

Setting

Polynomial	for setting the order of the polynomial used in the fit and threshold values used during gamma line identification
Baseline	to select appropriate baseline for the fitted curve
Residual	for setting the type of residual data
Grid	enables or disables the grid in the upper window

Dataset	
Load	loads a peaklist for the actual nonlinearity fit
Remove	Drops a peaklist data and remove it from the actual nonlinearity fit
Calculate	automatically calculates the nonlinearity curve from the input data
Report	
Short	generates a short report from the current fit in text format
CSV	generates an extensive report from the current fit in CSV format

Before using the utilities make sure that the NUCLID.STD file with the data of the standards is in your working directory (the directory from where the HYPC program was started).

The file NUCLID.STD is a simple text file containing nuclear and certification data of selected radioactive sources (152-Eu, 182-Ta, etc. used for calibration purposes in Evaluation, Nonlinearity, Efficiency and FWHM modules. This file is user editable, but you must keep its fixed format.

Hypermet-PC tries to load this file from the current directory. If Nuclid.std is not found there, program tries to load it from the directory where Hypermet-PC resides. If this file not found or an error occurred during load, you won't be able to use nonlinearity, efficiency, fwhm calibration modules and some features of Hypermet-PC will be disabled.

The following lines serve as an example for a Nuclid.std file (a small part only):

```
#Ra-226   ;TOI96 (not from Helmer) 226-Ra+214Pb+214-Bi in equillibrium
T1/2:  584320  2556
    46.539  0.001      0.0424     0.0009  ;210-Pb,from Debertin 1988
    53.226  0.002      0.0111     0.0005
   186.10   0.10       0.0350     0.0005  ;214-Pb
   241.981  0.008      0.0750     0.0010
   295.213  0.008      0.185      0.003
   351.921  0.008      0.358      0.005   ; 214-Pb
   609.312  0.007      0.448      0.005   ; 214-Bi from here upwards
   665.453  0.022      0.0129     0.003
   768.356  0.010      0.0480     0.0007
   806.174  0.018      0.0112     0.0003
   934.061  0.012      0.0303     0.0005  ;+934.0 keV(0.05%)
  1120.287  0.010      0.148      0.002
  1155.190  0.020      0.0164     0.0004
  1238.110  0.012      0.0586     0.0008
  1280.960  0.020      0.0144     0.0003
  1377.669  0.012      0.0392     0.0008
  1401.50   0.04       0.0155     0.0017
  1407.98   0.04       0.028      0.04
  1509.228  0.015      0.0212     0.0004
  1661.28   0.06       0.0114     0.0003
  1729.595  0.015      0.0288     0.0006
  1764.494  0.014      0.1536     0.0020
  1847.420  0.025      0.0204     0.0004
  2118.55   0.03       0.0114     0.0003
  2204.21   0.04       0.0486     0.0009
  2447.86   0.10       0.0150     0.0004
```

```
#Am-241   ;8th Table of Isot.1996 App. C (Helmer);T1/2 from IAEA91TECDOC
T1/2: 157850  240
    26.3446  0.0002    0.024    0.001
    59.5409  0.0002    0.360    0.004


#CERTIFICATES: ;Certificates for absolute detector efficiency calibration

#Am85-264  ;OMH, Owner:Simi
Nuclide: Am-241
Activity: 421.2 (1.0%)
RefDate: 10-01-1985 12:00:00

#Am96-293   ; OMH, Owner: Simonits
Nuclide: Am-241
Activity: 22.46 (1.0%)
RefDate: 12-01-96 12:00:00

#Ba85-211   ;OMH, Owner:Simi
Nuclide: Ba-133
Activity: 456.4 (1.5%)
RefDate: 10-01-1985 12:00:00# ;signs the end of Nuclid.std file
```

1) First section describes the gamma lines of nuclides (which are appropriate for calibration purposes):

```
#<nuclide name>   [;comment for nuclide]
[T1/2: <half-life in days> <abs. HL unc. in days> [d]]
<energy> <unc. of energy> <abs. intensity> <abs. unc. of intensity>
<energy> <unc. of energy> <abs. intensity> <abs. unc. of intensity>
<energy> <unc. of energy> <abs. intensity> <abs. unc. of intensity>
…
```

2) Second section describes certificates for sources suitable for detector efficiency calibration.

- First a section-starter indicates that this is the second section:

```
#CERTIFICATES:
```

- Next lines describes certificates of sources in them. It is possible to measure with a combined source (two or more nuclide in one certificate).

```
#<certificate name>   [;comment for certificate]
Nuclide:  <nuclide name>
Activity: <activity> (<relative unc. of activity in percent>%)
RefDate:  <time of activity measurement in mm-dd-yyyy hh:mm:ss format>
```

Selecting the **Dataset/Load** menu and one of the report file formats from the appearing scroll window, a HYPERMET report can be read in. A subsequent scroll window will offer the names of the standards stored in the NUCLID.STD file. Select the required standard! If more than one standard is included in your measurement you may select them one by one withthe mouse while pushing the <Ctrl> key.

The program automatically identifies those lines in the report file which correspond to the energies of the standards. Then it calculates the nonlinearity data, their standard deviations, and plots these values on the screen with different colours. Each data set has its own info page showing the name of the report file used and listing the included standards. Above this info page the inscription NONLINEARITY tells what type of calibration curve is being created.

The cursor can be moved along those plotted data points which belong to the info page currently visible. On the cursor info bar at the bottom of the screen, the position in channel unit and the data value with its standard deviation are displayed for the current cursor location. Any selected data point can be deleted from the evaluation and the screen by pushing the <DEL> key, even after a fit has been made. A complete data set can also be removed at once, by choosing the **Dataset/Remove** menu. Both ways of deleting initiate a new fit automatically if a first fit has already been performed (see below).

A fit can be performed by clicking on the **Calculate** menu. The resulting curve is plotted as a white line with the standard deviation shown as a dark grey area around it. A blue-coloured info page displays the degree of the fitted polynomial, the normalised chi-square (chi-square devided by the degree of freedom) and the fitted coefficients with their standard deviations. The data set info subpages are completed with the normalising factor and the average chi-square for each data set. (On the nonlinearity calibration subpages the average chi-squares corresponding to the different standards used are also shown separately.) The latter are coloured in red if the average chi-square exceeds the acceptance threshold (see below). The chi value for the data point at cursor position is displayed on the cursor info bar.

The degree of the fitted polynomial can be changed by clicking on the **Setting** menu. The thresholds for peak identification and the chi-square limit for acceptance of fit can also be changed here.

To exit from the utility click on the **File/Return** menu.

Efficiency calibration module

With the Efficiency utility you can easily determine the full-energy peak efficiency versus gamma-ray energy function of your detector. The aim of this module is to provide an easy-to use and fully automated method for determining the relative or absolute detector efficiency curves with the least possible user interaction. The provided polynomial efficiency curve can be used for comparing different detectors, as well as for analytical computations. Moreover, users can generate an efficiency corrected peak list report in the Eval module using a previously created detector efficiency curve.

For efficiency-corrected peaklist generation, user should

- determine the efficiency curve of the system with the Efficiency module, and
- apply the saved efficiency calibration file (the .EFF file) before creating a peaklist report in the Eval module.

The menu structure:

File

New	creates a new efficiency log file
Open	opens a previously saved nonlinearity log file
Save	saves the efficiency log file
Save as	saves the efficiency log file
Return	control returns to the Main module

Setting

Polynomial	for setting the order of the polynomial used in the fit and threshold values used during gamma line identification
Residual	for setting the type of residual data

Grid	enables or disables the grid in the upper window
Dataset	
Load	Loads a peaklist taken by a measurement from a non-calibrated source
Load Abs.	Loads a peaklist taken by a measurement from an absolutely calibrated gamma-ray source
Remove	Drops a peaklist data and remove it from the actual efficiency fit
Calculate	automatically calculates the efficiency curve from the input data
Report	
Short	generates a short report from the current fit in text format
CSV	generates an extensive report from the current fit in CSV format

To create an efficiency curve:

1. Measure some spectra (e.g. 5 spectra preferably with overlapping lines) with different radioactive sources (absolutely calibrated or uncalibrated, home-made) at the same source-detector geometry.
2. Load all spectra one by one and evaluate them in Eval module applying a two-point energy calibration and nonlinearity correction. Then save fitting results in Hypermet-PC Short, Peaklist or Sampo-90 PTF Report format.
3. Start Efficiency module with selecting Options / Qual. Assurance / Efficiency menu.
4. Load a previously saved peaklist into Efficiency module with Dataset / Load menu. If you have taken a measurement with an absolutely calibrated source, then use Dataset / Load Abs menu.
5. Select nuclide(s) according to current peaklist in the pop-up window (you can specify several nuclides at a time with the left mouse button while holding down <Ctrl> key.)Or, if you have taken the measurement with an absolutely calibrated source, then select the relevant source from the source list.
6. Load all peaklists into Efficiency module (repeat steps 4-5). Peaklists will be normalised to the first dataset and the Efficiency calibration will be automatically adjusted after loading each dataset. If an absolutely calibrated source is also involved in the efficiency curve determination, then all datasets will be normalised by the absolute calibrated one.
7. If results are not meaningful (missing lines, etc.), change settings by using Setting menu.

Notes:

- Efficiency module uses NUCLID.STD file to offer a list of nuclides or sources in Step 5. If you could not find your preferred nuclide or source, quit Hypermet-PC and edit this file with a text editor (Notepad etc.): insert the data of missing isotopes or sources. Next time you start Hypermet-PC , these changes will take effect.
- If Efficiency module can not identify all gamma lines associated with a selected nuclide, try to increase the identification threshold value under **Setting/Polynomial**. First remove the loaded dataset by pressing **<PageUp>** a few times to find the relevant info page and selecting **Dataset/Remove**. After you removed the dataset, load it in again by selecting **Dataset/Load**. Identification of gamma lines will now be made using new threshold values.

2. The Nuclide ID option

This option is intended for qualitative and quantitative analysis of gamma-ray spectra, applicable for almost every popular measurement method (e.g. different types of neutron activation analysis, prompt gamma activation analysis, fission product monitoring, charged-particle activation, photoactivation etc.). At this stage only a simple qualitative analysis of NAA and PGAA spectra is implemented. The NAA library contains 130 isotopes with data extracted from the Table of Radioactive Isotopes, 1986.

Analysing an NAA spectrum

Before starting an analysis...

First copy the STANDARD.BHL (Binary Hypermet-PC Library) and STANDARD.HLL (Hypermet-PC Library List) files from the distribution diskette to the directory where HYPC.EXE resides (if they are not found there). The binary library is used by the program, while the second one is its ASCII version.

Evaluate your spectrum with Hypermet-PC (**Eval** menu) and save the peaklist in short format with extension *.PKL. Be sure to provide an appropriate energy calibration for the spectrum using a previously created nonlinearity correction file (**Qual.Assurance** menu) and two well-known gamma lines, otherwise the qualitative analysis may fail. To help this action, you can use the STANDARD.HLL library list to look up proper calibration lines. Leave **Eval** by selecting **Return**.

If you started Hypermet-PC anew, load your spectrum using the **File**/**Open** command!

Start Nuclide ID!

To start Nuclide ID, select the **Options**/**Nuclide ID** submenu. Now you are in the Nuclide ID module where a new menu bar appears:

File	- loads your *.PKL file or returns to the previous section
Setting	- customises various measurement and analysis parameters
Analyse	- starts qualitative or quantitative analysis
View	- lets you browse your analysis results
Report	- creates reports of analysis results
Library	- lets you browse the libraries

In the next step load your peak list file *.PKL using the **File** menu. Before you start analysis:

Set basic parameters for the spectrum!

Set parameters with the **Setting** menu. A pull-down menu appears:

Method	here several measurement methods can be selected (only NAA - Thermal is available at present!)
Measurement	parameters characterising irradiation, measurement and sample (flux,. time, weight, etc.)
Nuclides	range of nuclides
Parameters	statistical criteria for nuclide identification
Load	not implemented yet
Save	not implemented yet

If you have set the `Cooling Time` parameter or you do not want to modify other settings, jump to section "***Start analysis!***"

Select the **Measurement** submenu! An input window appears. For qualitative analysis only the `Cooling Time` parameter is needed. Select the appropriate time unit with the `Time unit` switch and enter the parameters characterising your sample and measurement. The contents of the `Sample Code` field will be included in the analysis report file. All the other input fields are not used for analysis at present.

Customise nuclide range!

To change the required range of nuclides from the selected library, select the **Nuclides** submenu and click on the `Change nuclide range` button. By doing this you can temporarily remove or reinsert individual nuclides from the library. (To select more than one isotope at the time, hold down the <Ctrl> key and click on the isotopes.) The actual nuclide range is shown in mass numbers and chemical symbols on the top line of the input window.

If the cooling time is larger than 20 times the half life of a given nuclide, Nuclide ID automatically excludes that nuclide from the analysis, so you need not remove these nuclides manually. At present, this exclusion affects only those nuclides with decay type "I" (see decay type codes in [7]). Generally, you need to use the **Nuclides** submenu only if you have found doubtful interferences in the analysis report file.

Fine-tuning the analysis parameters

Select the **Parameters** submenu to fine tune the selection criteria. The `ADDITIVE ENERGY TOLERANCE` is used when searching through the peak list report file for peaks included in the library. The program uses peak energy values from the peak list and the library with their corresponding uncertainties. When comparing measured energies with the library values the combined uncertainties should be used. Since in practice the measured energy values may differ from the expected literature values by several standard deviations due to electronic shifts, an artificially

introduced additive energy tolerance value, which is usually greater than the combined error, is more meaningful when identifying the peaks.

This additive error can be expressed simply as a linear function of the gamma-ray energy. To set the parameters for this linear error function, enter the energy value and the related additive error for two points in the spectrum. For a typical NAA application, the default tolerance values are acceptable. If your analysis results are different from that you have expected, try to improve the energy calibration and/or increase the tolerance value.

`Probability Filters` are used to classify peak assignments. The first number is the minimal acceptable probability for a peak belonging to a matching nuclide, and is used as a criteria for storing the assignments in the internal database. If this value is set too low, there will be an unrealistically high number of matching peaks for a library peak. *If this value is set too high (i.e. above 0.25), even well-defined peaks may be overlooked!*
The second probability value is used during report generation. In the report identified nuclides are listed according to qualifier Q, and only those passing this 'cut-off' value will be listed. We strongly recommend to change only the second value.

Start qualitative analysis!

Select **Analyse** for qualitative analysis. An input window is shown where you can see the most important parameters for peak search. Set the energy range in keV and press "OK" to start analysis. Nuclide ID now checks all nuclides involved - as you can see at the top right corner of the screen. When analysis ends, you can see the results with the **View/Full** submenu. Report file will be displayed on a text screen - ocassionally you can expect a rather long list. The full listing consists of a number of sub-results, e.g. qualifiers, nuclides excluded by their half life, nuclides found by relevant peak energies, peaks of different nuclides identified in the spectrum etc. If the results are not acceptable (e.g. unexpected nuclides appears in the list or too much nuclides are listed in the `"nuclides by their qualifier number"` section), modify the parameters and restart the analysis! *If an important nuclide is not found in the report, check the energy (or nonlinearity) calibration first!*
If you would like to save your results in an ASCII file, choose **Report** menu. (The default extension of the output file name is *.NUI.)
Here is the end of our quick tour in qualitative analysis.

Let us show a good example of Nuclide ID capabilities!

For the sake of complexity, an artifically mixed standard sample was irradiated and analysed. (Both the spectrum and the relevant peaklist file can be found on the distribution diskette as "FA_3.MCA" and "FA_3.PKL")

The elemental composition of the original sample is the following:

Radionuclide	Component mass in sample (mg)	Other detectable nuclide
46Sc	0,00005	
51Cr	0,003	
59Fe	0,5	
60Co	0,001	
65Zn	0,003	
75Se	0,0003	
86Rb	0,02	
85Sr	0,2	
95Zr	0,3	+95Nb
114mIn	0,002	
124Sb	0,001	+122Sb
170Tm	0,001	
169Yb	0,001	
233Th	0,005	233Pa
134Cs	0,001	

Let's investigate some parts of the result file "FA_3.NUI"!
First, take a look at the Q value's list:

```
Analysis data from Nuclide ID  -       (95.11.28, 13:13)
   Spectrum:    f3_a.mca
   Peaklist:    f3_a.pkl
   Sample code: sample#001

      Nuclides by their qualifier number (Q>0.5)
      ------------------------------------------
   Qualifier        Peak searched/found

  Q(   60Co)= 0.953            2/2
  Q(   46Sc)= 0.951            2/2
  Q(   95Nb)= 0.917            1/1
  Q(   65Zn)= 0.915            1/1
  Q(  124Sb)= 0.908           13/12
  Q(   95Zr)= 0.888            2/2
  Q(  134Cs)= 0.851            9/9
  Q(   51Cr)= 0.848            1/1
  Q(  233Pa)= 0.839            9/9
  Q(   59Fe)= 0.835            4/4
  Q(   85Sr)= 0.803            1/1
  Q(  122Sb)= 0.799            4/4
  Q(   86Rb)= 0.782            1/1
  Q( 114mIn)= 0.730            3/3
  Q(  175Yb)= 0.685            6/5
  Q(   75Se)= 0.664            9/7
  Q(  170Tm)= 0.648            1/1
  Q(  114In)= 0.519            2/1
```

The above list shows nuclides by their qualifier number where the Q cut-off value was 0,5.
The next section of the report contains some of the 32 nuclides excluded by half life constraints:

```
     Nuclides excluded by half life

  Cooling time was 604800 sec
  Nuclides excluded if  Tcool > T(1/2)*20  and irradiation/decay code=1

     Nuclide       T(1/2) [sec]       T(1/2)*20    DecayType
-------------------------------------------------------------
  1.    27Mg            567.72        11354.40         1
  2.    28Al            134.40         2688.00         1
  3.     37S            303.00         6060.00         1
  4.    49Ca            522.90        10458.00         1
  5.    51Ti            345.60         6912.00         1
  6.     52V            225.00         4500.00         1
  7.    56Mn           9282.60       185652.00         1
  8.    65Ni           9072.00       181440.00         1
  9.    66Cu            306.00         6120.00         1
   .
   .
   .
 28.  165mDy             75.48         1509.60         1
 29.   171Er          27072.00       541440.00         1
 30.  176mLu          13248.00       264960.00         1
 31.  180mHf          19800.00       396000.00         1
 32.  188mRe           1116.00        22320.00         1
```

The next section describes the assignments made by literature energy match. The P shows below the "probability" of assigning literture and measured peak energies. Naturally, during the peak assignment more literature peak can be assigned to one measured peak.

```
 Nuclides by peaks

Spe.pk|      Energy            Area
  #   |       [keV]            [cnt]
------+-------------------------------------------------------------------------
    1.    E=    50.039   Area=   30750
    2.    E=    51.058   Area=   63342
    3.    E=    52.647   Area=   29616
                         P(  133Ba,  7.)= 0.251   [E_litr=    53.161]
    4.    E=    54.181   Area=   17498
    5.    E=    57.663   Area=   26106
                         P(  143Ce,  2.)= 0.493   [E_litr=    57.356];
                         P(  159Gd,  2.)= 0.452   [E_litr=    58.000]

    6.    E=    59.385   Area=   16183
                         P(  111Pd,  6.)= 0.339   [E_litr=    59.820]
    7.    E=    63.334   Area=   62611
    8.    E=    75.462   Area=   10464
                         P(  233Pa,  6.)= 0.810   [E_litr=    75.354];

    9.    E=    84.460   Area=  103755
                         P(  170Tm,  1.)= 0.648   [E_litr=    84.255];
                         P(  182Ta, 13.)= 0.623   [E_litr=    84.681]
     .
     .
     .
  139.    E=  1620.960   Area=      66
  140.    E=  1647.490   Area=      95
```

```
  141.    E=  1691.000   Area=   31063
                         P(  124Sb,  2.)= 0.970   [E_litr=  1690.980]
  142.    E=  1764.421   Area=     186
  143.    E=  1957.788   Area=      56
  144.    E=  1970.110   Area=     268
  145.    E=  2009.568   Area=    1237
  146.    E=  2039.121   Area=     150
```

The next list contains some of interest cases listed in the "Peaks by nuclides" section:

```
42K peaks  Q(42K)=0.363   HL=44496.00 s   DecayCode:  1
 Spe.pk.|  Litr.  |Rel.Int. |Meas. Energy| Litr. En. |  P(ij)
   #    |  peak # |(max=1.0)|   [keV]    |   [keV]   |
 -------+---------+---------+------------+-----------+--------
    54. |     2   |   0.019 |    312.007 |   312.350 |  0.514

59Fe peaks  Q(59Fe)=0.835   HL=3844454.40 s   DecayCode:  1
 Spe.pk.|  Litr.  |Rel.Int. |Meas. Energy| Litr. En. |  P(ij)
   #    |  peak # |(max=1.0)|   [keV]    |   [keV]   |
 -------+---------+---------+------------+-----------+--------
   109. |     1   |   1.000 |   1099.306 |  1099.251 |  0.913
   120. |     2   |   0.765 |   1291.602 |  1291.596 |  0.991
    34. |     3   |   0.055 |    192.528 |   192.349 |  0.694
    26. |     4   |   0.018 |    142.827 |   142.652 |  0.699

60Co peaks  Q(60Co)=0.953   HL=166321175.04 s   DecayCode: 4B
 Spe.pk.|  Litr.  |Rel.Int. |Meas. Energy| Litr. En. |  P(ij)
   #    |  peak # |(max=1.0)|   [keV]    |   [keV]   |
 -------+---------+---------+------------+-----------+--------
   124. |     1   |   1.000 |   1332.486 |  1332.501 |  0.977
   114. |     2   |   0.999 |   1173.283 |  1173.237 |  0.928


69Zn can't be definitely assigned to spectrum.   Q(69Zn)=0.004
```

This method is not yet fully tested on every application area of neutron activation analysis, but even in this stage it helps reduce drastically the time of analyst's interaction in evaluating NAA measurements.

The Dual LFC option

The Loss-Free Counting (LFC) method provides the ability of performing real-time correction of system counting losses needed e.g. when measuring short-lived radionuclides in NAA. Among the several implementations the Westphal's Virtual Pulse Generator technique of LFC seems to be the most advanced which proved to be accurate up to 700 kHz. Since the LFC adds n rather than one for every event that is stored, the counting statistics of the corrected spectra is non-Poisson in nature. Consequently, the use of conventional peak search routines for LFC corrected spectra would result in hundreds of false peaks.

A straightforward solution, marketed by Canberra, is the Dual Spectrum LFC module which accumulates a loss-free corrected and an uncorrected spectrum simultaneously in adjacent halves of

the memory. Analysis of such a tandem spectrum provides more accurate quantification of the data than analysis from a single spectrum.

When the **DualLFC** mode is selected, the Hypermet-PC performs special fit on the tandem spectrum. The settings and the preliminary steps of the fitting are the same as in normal mode, but the Hypermet-PC always starts with a normal peak search and fit in the uncorrected spectrum even if the corrected spectrum is displayed. After the region has been fitted and the region and the peak parameters have been stored in the **Logbook** database, the program starts a new fit in the corrected part of the spectrum with the same region boundaries. In order to eliminate a number of spurious peaks, no peak search is performed in this region and the peak positions are read in from the database. The two fitting parameters of FIT and TRY are temporarily switched on and set to one, respectively. In a normal spectrum, channel counts follow Poisson statistics. Thus the reciprocal value of counts are used as weighting factors for the least squares fitting. For the LFC corrected spectrum the same relative deviation is expected as in the uncorrected spectrum. Consequently, in order to apply the least square method properly in the corrected spectrum, the channel counts of the uncorrected spectrum are used to estimate the deviation of the counts in the corrected spectrum, then to calculate the weighting factors. So far the experience with the chi-square tests confirms the above expectation.

If the program fails or does not perform properly, first check the minimum computer requirements (see Introduction**.)** If the problem persists, please inform us at the address below:

Dr. Béla Fazekas
Dept. of Nuclear Research, Institute of Isotopes,
H-1525 Budapest P.O.B. 77, HUNGARY
Email: bela@alpha0.iki.kfki.hu
Tel.: (1) 395-9073 Telefax: (1) 395-9075

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[7] G. W. Phillips, K. W. Marlow : "Program HYPERMET for Automatic Analysis of Gamma-Ray Spectra from Germanium Detectors", NRL Memorandum Report 3198, NAVAL RESEARCH LABORATORY, Washington, DC; Radiation Technology Division, January 1976 (see nrl3198.doc on the installation disk)

APPENDIX A

Installation notes for Hypermet-PC 5.0 for DOS

(see readme.txt file on the installation disk)

```
Welcome to Hypermet-PC!
We hope you will enjoy this superior and easy-to-use program for
automatic evaluation of complex gamma-ray spectra.

Please, follow carefully the instructions for installation below.

=========================================================================

  How to install Hypermet-PC
  --------------------------

  - Ensure that your computer meets the requirements, described
    in the 'System requirements for Hypermet-PC' section.

  - Read the 'Pre-installation notes' section.

  - Run the 'HINSTALL.EXE' program from the installation floppy disk
    (or from hard disk) and set the parameters according to your
    needs and your computer environment.

  - Read the operating system-specific installation notes to complete
    the installation.

-------------------------------------------------------------------------

  How to run Hypermet-PC
  --------------------------

  - Attach your hardware key to your computer's parallel port
    (see 'Hardware key' section)

  - Start HYPC.EXE
    (see the 'Starting Hypermet-PC' section)

  - If any problem arises, see 'Troubleshooting Hypermet-PC' section.

-------------------------------------------------------------------------

  System requirements for Hypermet-PC
  -----------------------------------

  Hardware:
  - Intel 80386 DX CPU or above (or compatible)
  - mathematical co-processor
  - 2 MB RAM
  - about 3 MB free hard-disk space for Hypermet-PC,
    and another 2 MB while running the program
  - standard VGA video card (640x480 resolution, 16 colors) or better
  - mouse
```

- 3,5" floppy drive (for the installation process).

Software:
- MS-DOS 6.x or any Windows system above Windows 3.1 (inclusive)
- MS-DOS mouse driver software from your mouse manufacturer.

Sophisticated algorithms involved in Hypermet-PC need a lot of computing power, so the specified configuration is the 'low end'. We suggest using a faster CPU (Intel 80486 or Pentium) for complicated tasks such as fitting multiplets or peaks on complicated background.

Pre-installation notes

- Hypermet-PC is a 16-bit DOS extender application, that is a DOS program which accesses extended memory (not only the lowest 640 Kbytes, but all available memory up to 16 MB). Therefore, a little more attention is needed during the installation and BEFORE THE FIRST USE:

  When you start the installation program, a checkbox appears with the title 'Using Hypermet-PC under Windows3.x'. You MUST place an X in the checkbox if you want to use Hypermet-PC under Windows3.x (click on the checkbox with the mouse or activate it by the pressing the Tab key a few times, then press space to toggle it).
  A WRONG SELECTION MAY CAUSE A CRASH WHEN HYPERMET-PC IS TRYING TO ACCESS AN EMPTY FLOPPY DRIVE!

==========

Installation notes for DOS

- Use information in this section if you start Hypermet-PC under DOS (i.e. when not using Windows's DOS emulator).

- Hypermet-PC has been tested only under DOS 6.x versions but probably works under versions 5.x as well.

- In order to use some of the advanced functions of the program you need to install a mouse driver under DOS. To test whether a mouse driver is present, start Hypermet-PC. If the mouse cursor (slanted arrow) does not appear on the graphics screen, your mouse driver is not installed. In this case see the 'Installing a DOS mouse driver' section.

- To speed up file I/O operations, we suggest the using of a disk-cache program such as SMARTDRV.EXE which is part of MS-DOS.
  Include the next line in your AUTOEXEC.BAT file (if AUTOEXEC.BAT is not containing it already):

  SMARTDRV

  This will enable disk cache for your drives next time, after rebooting your computer.

- If your computer has more than 16 MB RAM, then specific problems may occur. If you experience memory management problems, place the following line in your AUTOEXEC.BAT file to set this upper memory limit used by the program:

SET DPMIMEM=MAXMEM 16000

Please note that there are no spaces before and after the equation sign in the expression above. Changes take effect next time after you have rebooted the computer.

- To run Hypermet-PC, attach the hardware key to your computer's parallel (i.e. printer) port, preferably before turning your computer on.

  Rules of hardware key positioning:
  - Recommended position for Hypermet-PC's hardware key: connected directly to the parallel port.
  - Hypermet-PC's hardware key should be the first one (i.e. closest to the computer) if you are using more hardware keys at a time.
  - On some computers you should reboot your machine after you have connected the hardware key to the parallel communication port, but this is usually not required.

How to get help

- Hypermet-PC has a buit-in help facility, which can be accessed while running the program.

- A 'User's Manual' has also been created for Hypermet-PC.

- All documents can be found on our WWW site (http://www.iki.kfki.hu/nuclear/hypc.html).

Uninstalling Hypermet-PC

- Uninstalling Hypermet-PC is a simple task: just remove Hypermet-PC files and its directory from your hard drive.

Installation notes for Windows 3.x

- Use information in this section if you will start Hypermet-PC from Windows, version 3.x. In order to use Hypermet-PC after installation, you must start it in a 386 Enhanced Mode DOS Box. This can be achieved simply by creating a PIF file and placing it in your favorite Program Manager window.

  About 386 Enhanced Mode issues see your Windows documentation.

- If you want to use Hypermet-PC from Windows, create a PIF file for it. In the memory options, set 2 MB of Extended memory: this will be enough for everyday usage. The installation program also places an icon file into Hypermet-PC directory - you can use it when creating the PIF file.

- To run Hypermet-PC, attach the hardware key to your computer's parallel (i.e. printer) port, preferably before turning your computer on.

Rules of hardware key positioning:
- Recommended position for Hypermet-PC's hardware key: connected directly to the parallel port.
- Hypermet-PC's hardware key should be the first one (i.e. closest to the computer) if you are using more hardware keys at a time.
- On some computers you should reboot your machine after you have connected the hardware key to the parallel communication port, but this is usually not required.

How to get help

- Hypermet-PC has a buit-in help facility, which can be accessed while running the program. However, we provide its contents also in the form of a standard Windows help file, called 'HYPDOS.HLP'. If you just want to browse its contents, or search for and print out topics, you can easily do it as with any other Windows-compatible help file. Simply double-click on the 'HYPDOS.HLP' file as it appears in File Manager and Windows will activate it.

- A 'User's Manual' has also been created for Hypermet-PC.

- All documents can be found on our WWW site (http://www.iki.kfki.hu/nuclear/hypc.html).

Uninstalling Hypermet-PC

- Uninstalling Hypermet-PC is a simple task: just remove Hypermet-PC files and its directory from your hard drive. If you have used this program under Windows and created an icon for it, simply delete the icon from your program group.

Installation notes for Windows95 / Windows NT

Use information in this section if you will start Hypermet-PC from Windows95 or Windows NT.

- In order to use Hypermet-PC, you should create an icon for it on your desktop after installation. To achieve this, right-click on the Desktop with the mouse, select 'New/Shortcut' and press Browse. Find the installed HYPC.EXE and press Open, then press 'Next >'. Type 'Hypermet-PC 5.0 for DOS' for the shortcut name and click on the 'Finish' button. A new Hypermet-PC icon will appear on your desktop. (A nice icon file 'HYPC.ICO' is provided in the HYPC directory for the shortcut.)

- For convenient use, set 'Close on exit' in the checkbox.
  To set the 'Close on exit' option, right-click on the newly created shortcut and select 'Properties'. Click on the 'Program' tab and check the 'Close on exit' checkbox.
  If you disregard this, then after exiting the program a confusing black window will remain on the screen, saying: '... Press Ctrl-C to close this window ...'.

- To run Hypermet-PC, attach the hardware key to your computer's parallel (i.e. printer) port, preferably before turning your computer on.

Rules of hardware key positioning:
- Recommended position for Hypermet-PC's hardware key: connected directly to the parallel port.
- Hypermet-PC's hardware key should be the first one (i.e. closest to the computer) if you are using more hardware keys at a time.
- On some computers you should reboot your machine after you have connected the hardware key to the parallel communication port, but this is usually not required.

- IMPORTANT: If you are using Windows NT, you MUST install a hardware key system driver before use. If you disregard this, then Hypermet-PC will not function. About this system driver, see the 'Hardware key system drivers' section.

How to get help

- Hypermet-PC has a buit-in help facility, which can be accessed while running the program. However, we provide its contents also in the form of a standard Windows help file, called 'HYPDOS.HLP'. If you just want to browse its contents, or search for and print out topics, you can easily do it as with any other Windows-compatible help file. Simply double-click on the 'HYPDOS.HLP' file as it appears in Explorer and Windows will activate it.

- A 'User's Manual' has also been created for Hypermet-PC.

- All documents can be found on our WWW site (http://www.iki.kfki.hu/nuclear/hypc.html).

Uninstalling Hypermet-PC

- Uninstalling Hypermet-PC is a simple task: just remove Hypermet-PC files and its directory from your hard drive. If you have used this program under Windows and created an icon for it, simply delete the icon from your Desktop.

Hardware key system drivers

Hardware key system drivers are needed for Hypermet-PC hardware key only under Windows NT operating system. In order to work with your Sentinel hardware key provided for Hypermet-PC, you MUST install a system driver on your Windows NT system before the first run.

Our experience shows that you need to install a hardware key system driver under other operating systems ONLY IF the provided hardware key does not work properly.

How to install the driver?

1. Unpack the ZIP-ped file 'nt_key.zip' found in 'nt_key' directory (on disk2) into a temporary folder. Run SETUPX86.EXE.
2. A window appears with a menu bar. Select 'Functions' and 'Install Sentinel Driver' from the menu.
3. A dialog box will appear with the NT driver path. Change the path if necessary and press 'OK'.

4. Now the installation program copies the necessary driver files
   according to a following scheme:
       To SYSTEM32 directory   :   SNTI386.DLL
       To SYSTEM32\DRIVERS directory: SENTINEL.SYS
5. When the driver is installed, a 'Sentinel Driver Files Copied
   Successfully' message is displayed.
6. When complete, a message 'Driver Installed! Restart your system'
   message is displayed.
7. Press 'OK'.
8. Restart your computer.

How to get additional information about this system driver?

- See the 'User's Guide' compressed into SENTINEL.ZIP file. This
  is a Microsoft Write-formatted file, so you may double-click on it
  after you have uncompressed it and your Windows system will
  display the content of the file. This file is provided as it has
  been obtained from the Sentinel Technologies WWW Site, without
  any modification. (To uncompress this file, use e.g. PKUNZIP.EXE.
  This decompressing program may be found e.g. at our WWW site.)

- Visit 'Rainbow Technologies' WWW Site for recent updates of
  system drivers. You can find additional system drivers for DOS
  and Windows-based sytems there.
  Site address: http://www.rnbo.com

What command-line options are available for SETUPX86.EXE?

  /Q option runs the install without dialogs (Quiet Mode).
  /P{Full path to SENTINEL.SYS} to specify the path if the current
     directory is not the directory where SETUPX86.EXE resides.
  /O to unconditionally overwrite the existing driver files.
     Without /O, the existing driver will be preserved if it
     is newer than the one to be installed.
  /U to uninstall the existing driver;
     e.g.,
      SETUPX86.EXE /Q /O /PD:\PROUDCT\DRIVERS\WIN_NT\I386
      SETUPX86.EXE /Q /U   (to uninstall the driver)

Parts taken from Sentinel System Drivers Version 5.3 README.TXT File
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All rights reserved.

==========

Installing a DOS mouse driver

- If your mouse driver program is MOUSE.COM or MOUSE.EXE and it
  may be started by typing 'MOUSE' from DOS command prompt, then
  place a statement in your C:\AUTOEXEC.BAT file:

  MOUSE

  This command starts the mouse driver program during computer
  startup.

  If this does NOT work:

- Check the mouse using another DOS-based program (e.g. Norton Commander). If mouse works well using the another program, a problem may have occured with your mouse driver.
  In the latter case you need an expert to install your DOS mouse properly.

  Troubleshooting for Hypermet-PC

- When browsing fits or other results in Hypermet-PC, the program switches back to text mode screen to display the large amount of information quickly. Under Windows95 and Windows NT, this involves reduction of the Hypermet-PC window from full-screen size to a smaller size. This is NOT an error, but a property of the operating system. To switch from this reduced-size text screen back to full-screen mode, simply press 'Alt+Enter'. Next time Hypermet-PC will display information on a full-sized screen.

- If you have trouble with the installation program, try to decompress the packed installation files yourself.
  To do this, type HINSTALL.EXE /? at the DOS Prompt and follow instructions on the screen.

- If you experience problems with Hypermet-PC, please inform us about the error via e-mail to the following address:

  E-mail: bela@alpha0.iki.kfki.hu

  Known problems in Hypermet-PC 5.0

- The program hangs up some Windows95 systems when switching between graphics and text video modes. Our experience shows that this is due to some erroneous video drivers (especially for Tseng-6000 series). Please, consult the video card manufacturer how to obtain an updated driver file.

- Please visit our WWW site for detected bugs and program updates:
  http://www.iki.kfki.hu/nuclear/hypc.html

==========

 Hypermet-PC 5.0 for DOS
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 http://www.iki.kfki.hu/nuclear/hypc.html
 E-mail: bela@alpha0.iki.kfki.hu

---
end of file

APPENDIX B

Notes on examples for Hypermet-PC 5.0 for DOS

(see examples.txt file on the installation disk)

```
This file contains general information about sample
spectrum files, calibration files, as well as report
files with/without efficiency and nonlinearity
corrections, provided by the developers of
Hypermet-PC for practising purposes.
The files are automatically copied to your hard disk
by the Hypermet-PC 5.0 installation program.

Please note that if a spectrum has been taken with
Dual LFC option ON, then you must switch on Dual LFC
evaluation mode.

To switch Dual LFC mode, select Options / Dual LFC /
Corrected menu.
-----------------------------------------------------

SPECTRUM FILES
--------------

 Spectrum        Dual LFC    Settings file     Log file

 ag110m.dat        yes       ag110m.set        ag110m.log
 am85264a.dat      yes       am85264a.set      am85264a.log
 am85264b.dat      yes       am85264b.set      am85264b.log
 ba85211a.dat      yes       ba85211a.set      ba85211a.log
 ba85211b.dat      yes       ba85211b.set      ba85211b.log
 cd85283.dat       yes       cd85283.set       cd85283.log
 co56a.dat         yes       co56a.set         co56a.log
 co56b.dat         yes       co56b.set         co56b.log
 co85185a.dat      yes       co85185a.set      co85185a.log
 co85185b.dat      yes       co85185b.set      co85185b.log
 co88075a.dat      yes       co88075a.set      co88075a.log
 co88075b.dat      yes       co88075b.set      co88075b.log
 cs85230a.dat      yes       cs85230a.set      cs85230a.log
 cs85230b.dat      yes       cs85230b.set      cs85230b.log
 eu80297a.dat      yes       eu80297a.set      eu80297a.log
 eu80297b.dat      yes       eu80297b.set      eu80297b.log
 ra37076.dat       yes       ra37076.set       ra37076.log
 ta182a.dat        yes       ta182a.set        ta182a.log
 ta182b.dat        yes       ta182b.set        ta182b.log

 soil7.dat          no       soil7.set         soil7.log
 difflin1.dat       no
 difflin2.dat       no
-----------------------------------------------------

  CALIBRATION FILES
  -----------------
```

```
  demo.eff  eff   Efficiency calibration file
  demo.fwh  fwh   Resolution determination file
  demo.lin  lin   Nonlinearity calibration file
-------------------------------------------------------

  REPORT FILES WITHOUT CORRECTIONS
  -------------------------------

                  For Nonlin

 ag110m.pkl       yes
 am85264a.pkl
 am85264b.pkl
 ba85211a.pkl     yes
 ba85211b.pkl     yes
 cd85283.pkl
 co56a.pkl        yes
 co56b.pkl        yes
 co85185a.pkl
 co85185b.pkl
 co88075a.pkl
 co88075b.pkl
 cs85230a.pkl
 cs85230b.pkl
 eu80297a.pkl     yes
 eu80297b.pkl     yes
 ra37076.pkl      yes
 ta182a.pkl       yes
 ta182b.pkl       yes
-------------------------------------------------------


  REPORT FILES WITH NONLINEARITY CORRECTION FOR
  ---------------------------------------------
  EFFICIENCY AND RESOLUTION DETERMINATION
  ---------------------------------------

                Efficiency    Certificate   Isotope

 ag110ml.pkl    relative                    Ag-110m
 am8526al.pkl   absolute      Am85-264      Am-241
 am8526bl.pkl   absolute      Am85-264      Am-241
 ba8521al.pkl   absolute      Ba85-211      Ba-133
 ba8521bl.pkl   absolute      Ba85-211      Ba-133
 cd85283l.pkl   absolute      Cd85-283      Cd-109
 co56al.pkl     relative                    Co-56
 co56bl.pkl     relative                    Co-56
 co8518al.pkl   absolute      Co85-185      Co-60
 co8518bl.pkl   absolute      Co85-185      Co-60
 co8807al.pkl   absolute      Co88-075      Co-57
 co8807bl.pkl   absolute      Co88-075      Co-57
 cs8523al.pkl   absolute      Cs85-230      Cs-137
 cs8523bl.pkl   absolute      Cs85-230      Cs-137
 eu8029al.pkl   absolute      Eu80-297      Eu-152
 eu8029bl.pkl   absolute      Eu80-297      Eu-152
 ra37076l.pkl   absolute      Ra370-76      Ra-226
 ta182al.pkl    relative
 ta182bl.pkl    relative


  REPORT FILE FOR SOIL71.DAT
  --------------------------
 soil7l.pkl
```

APPENDIX C

Files on the installation diskettes for Hypermet-PC 5.0 for DOS

(see filelist.txt file on the installation disk)

```
DISK1
 -----

 HINSTALL.EXE - Installation program for Hypermet-PC
 HYPMAIN.HPK  - Main program package
 HYPNUID.HPK  - Nuclide ID package
 HYPHLP.HPK   - Help file package
 README.TXT   - Readme file for installing
 EXAMPLES.TXT - Readme file for example files
 FILELIST.TXT - This file


 DISK2
 -----

 EXAMPLES.HPK - Examples package
 HYPDOS.HLP   - Windows help file for Hypermet-PC

 \MACRO directory:
   EFFMACRO.BAS -  Visual Basic code for computing
                   efficiency in Microsoft Excel
   EFFMACRO.XLS -  Microsoft Excel sheet for
                   computing efficiency

 \DOC directory:
   NRL3198.DOC  -  Technical documentation about
                   original HYPERMET algorithm

 \NT_KEY directory:
   NT_KEY.ZIP   -  Hardware key system driver for
                   Windows NT
```

The program development was supported partly

by the

National Committee for Technological Development (OMFB), Hungary